NOAA National Weather Service

NextGen Architecture and Infrastructure Development

Weather Information Database (WIDB) Information Technology System Design Specification

Initial Draft Version 0.1

Re: Task 3.2.1.2 of GSA Schedule Order DG133W-09-NC-0492

(GSA Schedule No. GS23F0286P)

Provided to NOAA National Weather Service

Provided by Skjei Telecom, Inc.

December 14, 2009

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1 Executive Summary

The Cube will be implemented as a virtual network of databases, consisting of a set of distinct data repositories located in different geographical locations accessible via network enabled web services. Operations of the Cube will also support the Single Authoritative System (SAS), which will provide users with a single point for approved, authoritative aviation weather information. Independently managed data sources will be under the control of the owning agents such as NOAA, FAA, DoD, and possibly other Government and commercial weather information providers.

The NOAA IT architecture and design will follow a Web Services-enabled, SOA-based System of Systems design approach in the implementation of its inter-enterprise application integration. Systems-of-Systems are defined by the independence of their respective components, their evolutionary nature, emergent behaviors, and a geographic extent that limits the direct interaction of their components to exchange information. The SOA-based nature of the approach makes use of a federated registry/repository that allows for the discovery of supported Cube services and their respective metadata, and the weather products and data sets these services provide.

The NOAA IT architecture and design development steps include:

1. Derivation of functional and performance IT requirements.
2. Identification of weather products/data sets required for inclusion in Cube their respective data formats, update frequency, and sizes.
3. Identification of candidate systems for inclusion in Cube.
4. Identification of Web Services used to enable network-enabled access to Cube products and resultant data exchange formats.
5. Development of an architecture required to support access to Cube weather products from candidate systems, via Web services and data exchange formats, while abiding by key functional and performance requirements, and remaining compatible with efforts of other Cube participants.
6. Development of an overall design required to implement the defined architecture.
7. Development of prototype Reference Implementations of various Cube components.
8. Refinement of overall design based on lessons learned from Reference Implementation development efforts.
9. Creation of a vendor procurement / acquisition package.
10. Selection of a vendor to create operational Cube components (based on prototype RIs) and to work with data providers and consumers in creating their respective Service Adaptor implementations.
11. Vendor development and deployment of Cube components.
12. Data providers system integration (service adaptor development) into the Cube.

The following key assumptions are driving NOAA's NextGen IT Architecture and Design:

- Use of a System of Systems approach
- Compatibility with key NOAA and NWS Enterprise Architecture guidance
- Compliance with NextGen requirements
- Supports IT ConOps Use Cases
- Compatible with evolving FAA Architecture
- Supportive of NextGen Enterprise Architecture definition of Business Services / Operational Activities

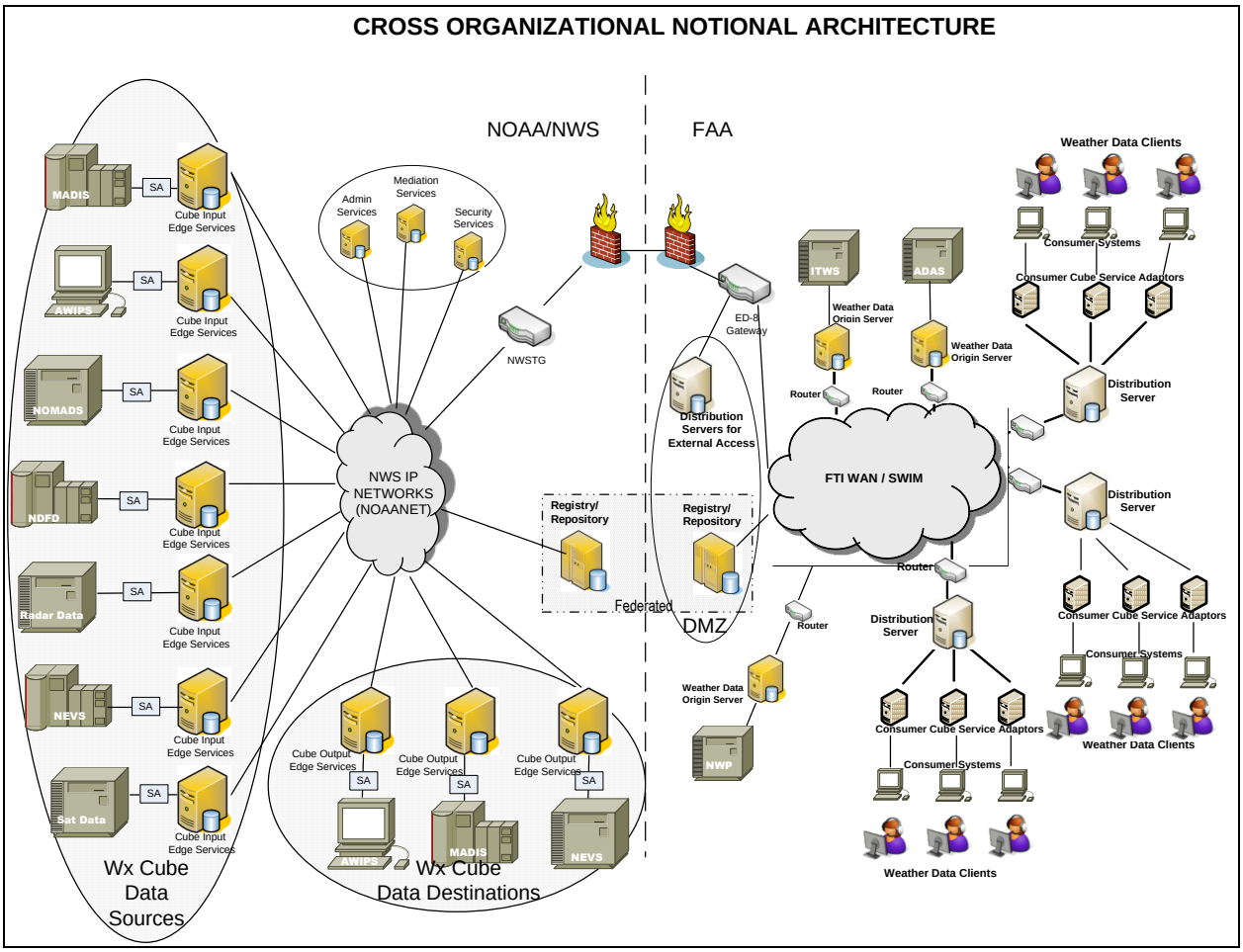
The weather products and datasets required to be included in the Cube are defined in the NextGen EI team's *IOC Product List,* which is supplemented with the FAA generated-*IOC Product Flow Sheet*. From those source documents, the NOAA and FAA systems required to be included as part of the Cube to serve as producers and consumers of these Cube products can begin to be identified.

The IT architecture framework is comprised of four layers

1. Telecommunications Infrastructure Layer - provides the network connectivity and associated monitoring infrastructure which consists of a secure Internet Protocol (IP) network, with standard naming and addressing management, routine network incident detection and response, and identity management.
2. Core Services Layer - ensures the interoperability of and allows the network enabling via web services through the use of open standards (HTTP, XML, REST, SOAP, etc)
3. Weather Services Layer – addresses the weather domain concerns of the Cube
4. Application Layer - consists of weather data users and systems that will provide data to and consume data from the Cube

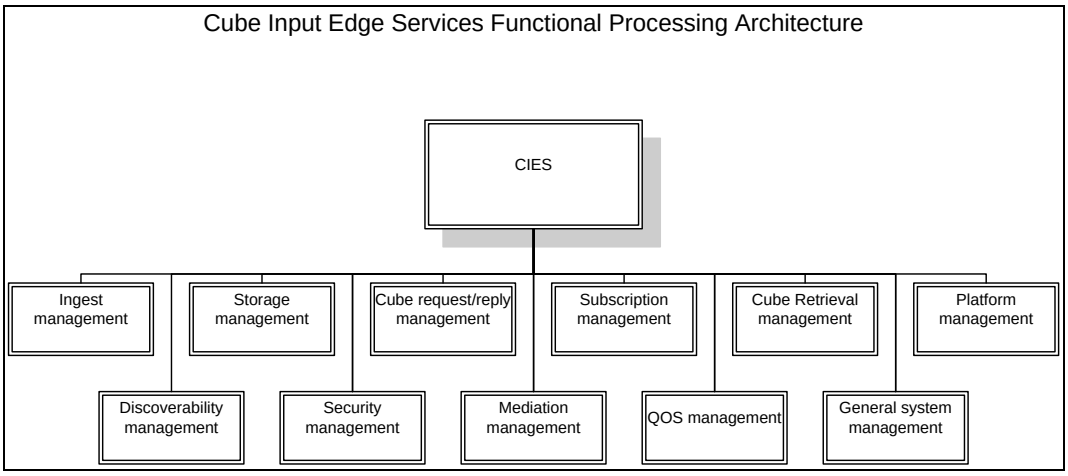
Within the Core Services Layer, network-enabling of NOAA systems involved in the Cube will be performed via Cube Input Edge Services (CIES) and Cube Output Edge Services (COES) as shown in the figure below and described as follow.

- Cube Input Edge Services (CIES)
    - Provides for the ingest of weather data required by the Cube (obtained either directly from the native source or via a Service Adaptor (SA))
    - Performs the necessary processing and local storage
    - Allows remote access to the weather data (or subsets thereof) via WCS/WFS/JMBL/other web services.
- Cube Output Edge Services (COES)
    - Provides for the request and retrieval of Cube data from remote WCS/WFS/JMBL/other web services
    - Performs the necessary processing
    - Allows access to the data by the requesting local destination system (via Service Adaptors (SA)).

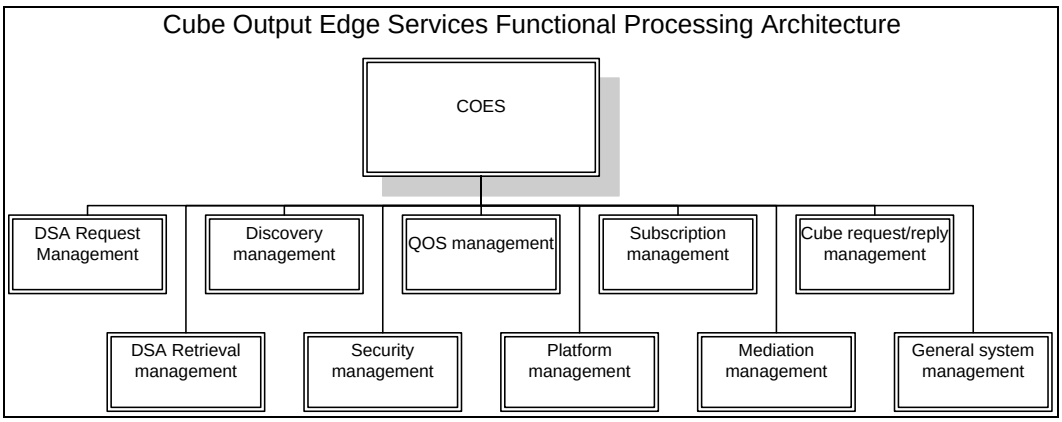


Alternative implementations allow for redundant CIES/COES (where multiple CIES/COES may interface to a single supporting data source or destination system), or shared CIES/COES (where multiple data source or destination systems may share a single CIES or COES).

The CIES perform a variety of functional activities, including those depicted in the figure below:



The COES perform a variety of functional activities, including those depicted in the figure below:



Service adaptors (SA) provide the necessary interface processing to the CIES and COES:

- Source Service Adaptor (SSA):
  - Transforming native or legacy source weather data that is required for publishing to the Cube into a format appropriate for ease of access via Cube Input Edge Services (e.g., transformed into one of several supported standards),
  - Making source weather data available to Cube Input Edge Services via a convenient and reliable network accessible means (e.g., web services-based communications) where such a means may not currently exist.
- Destination Service Adaptor (DSA):
  - Transforming weather data from a format appropriate for ease of access by Cube Output Edge Services into a native or legacy format compatible with the destination system
  - Supporting a mechanism to request access to data residing within the Cube

To ensure cross-organizational compatible, Web Service interfaces such as OGC's WCS/WFS standards are being considered, along with the DoD's JMBL implementation. Additionally, gridded data exchange formats such as NetCDF4 (and GRIB2), and non-gridded XML-based data exchange formats such as

WXXM (and JMBL) are being considered. A Registry/Repository solution that allows for cross-organization federation of discoverable service information has also been incorporated into the baseline architecture. A number of other potential standards related to SOA technologies, web services, and weather data representation are being considered and are addressed in a separate appendix.

Various other shared or stand-alone services may also be required to support NOAA's cube responsibilities, including:

- Administrative Services – which allow for the overview management, monitoring, configuration and operations of the overall Cube components
- Security Services – which perform security functions associated with the Cube
- Mediation Services – which are used to maintain interoperability between otherwise incompatible data formats or data exchange protocols

IT-related requirements which have been derived from numerous requirements sources are presented in Appendix A.

Design-based analyses related to IOC product sizes and frequencies of issue are presented in Appendix B.

Appendix C presents a discussion of alternate design approaches under consideration.

A number of open issues still remain, which include:

- Use of FAA-developed reference implementation as baseline for NOAA's CIES/COES (and resulting impact of the OGC-based, non-JMBL approach, that makes use of Oracle as its core database)
- Inclusion of textual / graphical weather products in the Cube, and the appropriate Web Service to support such product formats
- Determining more, and better requirements (i.e., performance and security requirements) and associated use cases and their inclusion in a final architecture / design solution
- Physical network considerations, including NOAANET to FTI connectivity
- Determining definitive source systems for each Cube product
- Determining weather product / dataset sizes to assess network bandwidth/throughput needs
- Determining data exchange formats for each weather product

2 Introduction

2.1 Background

A significant portion of the FAA's NextGen program is focusing on a major new direction in aviation weather information capabilities to help stakeholders at all levels make better decisions, particularly in

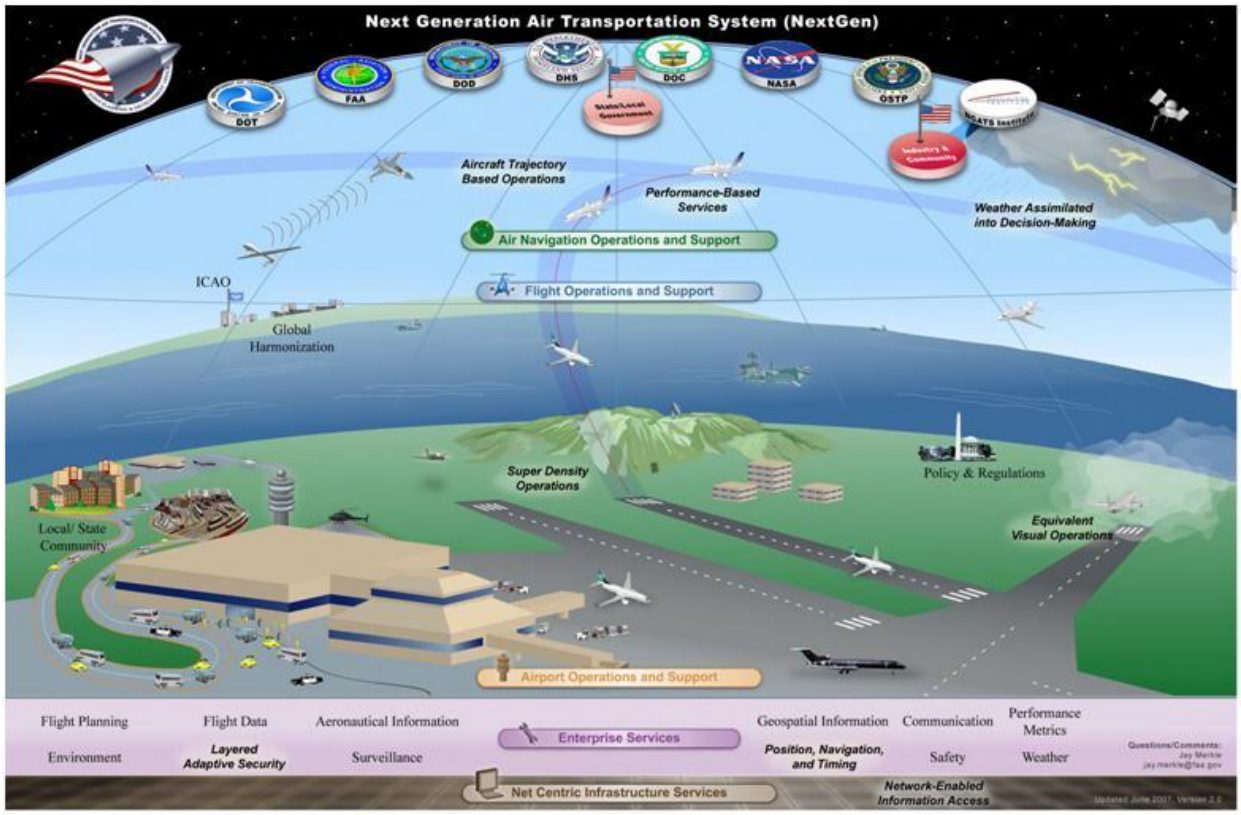
hazardous weather situations. NextGen-era aviation operations will be dependent on enhanced aviation weather capabilities based on three tenets:

- A common picture of all weather for all air transportation decision-makers and aviation system users
- Weather directly integrated into sophisticated decision support tools to assist decision-makers
- Utilization of Internet-like information dissemination capabilities to realize flexible and cost-efficient access to all necessary weather information

To this end, development and implementation of the NextGen 4-D Weather Cube is required. The Cube will enable access to all digital weather information needed by NextGen. The Cube will be implemented as a virtual network of databases, consisting of a set of distinct data repositories located in different geographical locations accessible via network enabled web services.

The guiding concept behind the Cube is to provide a common access point for aviation users to access aviation weather information and data from multiple data providers and sources and through the use of a network-centric architecture built on SOA principles, it will function and appear to users as a single database. The Cube will be implemented as a net-centric, distributed set of weather services available through this common access point with the actual physical locations of the data sources being transparent to the users. This distributed service model is in keeping with the net-centric dissemination vision of NextGen. Operations of the Cube will also support the Single Authoritative System (SAS), which will provide users with a single point for approved, authoritative aviation weather information for aviation weather products and datasets for given spatial and temporal domains.

Weather information through the Cube will be made available for use by any and all participants across the NextGen Air Transportation system, depicted in the figure below, in support of their various missions and responsibilities.



2.2 Purpose

The IT system design specification presented in this document encompasses a specific design necessary to realize the implementation of the concepts called out in the previously release companion document, the *WIDB IT System Architecture Document*. That IT architecture document presented an approach that NOAA NWS can implement to fulfill its obligation to develop the 4-D Weather Cube in support of JPDO and FAA NextGen weather requirements, as well as internal NOAA NWS requirements. The Cube itself is not being developed solely by NOAA NWS, rather it will be a federation of network-enabled services, some already existing, and some yet to be developed, and will be developed in close coordination with the FAA and the JPDO and its other members. The document is intended to guide system development and implementation in support of this coordinated effort.

The concept is that NOAA NWS will implement its side of the Cube (where "the Cube" is alternatively referred to within NOAA as the Weather Information Database (WIDB)) to ingest and subsequently serve out weather information and data of interest to the aviation community using a distributed, net-centric architecture that will interact with the complementary systems architecture being developed by the FAA. Ingested data will come from a wide range of data providers within NOAA and NWS, as well as some external sources, and will be provided to aviation weather users through the common access point of the Cube.

2.3 Key Players

The primary body with oversight of the NextGen Air Transportation System is the Joint Planning and Development Office (JPDO), which is a joint initiative of the Department of Transportation (DOT), Department of Defense (DoD), Department of Commerce (DOC), Department of Homeland Security (DHS), National Aeronautics and Space Administration (NASA), and White House Office of Science and Technology Policy (OSTP).

The effort driving this document is that portion of the larger NextGen program dedicated to the WIDB 4-D Weather Cube, which will be the source for aviation weather for the NextGen Air Transportation System and likewise for the FAA's National Airspace System (NAS). The primary roles in the design, development, and implementation of the Cube are DoC National Oceanic and Atmospheric Administration (NOAA) and DoT Federal Aviation Administration (FAA). Within NOAA, the primary responsibilities in these efforts falls to the National Weather Service (NWS) Office of Science and Technology (OS&T) and within the FAA they fall to the FAA's program for NextGen Network-Enabled Weather (NNEW).

The distributed nature of weather data makes the Cube a virtual database that will be composed of multiple, physical databases maintained at different locations by different organizations and agencies with various data consumers in other organizations and agencies. The independently managed data sources will be under the control of the owning agents such as NOAA, FAA, DoD, and possibly other Government and commercial weather information providers. Data consumers will be largely be within the same Government agencies.

A further breakdown of organizations involved with the Cube is given in Section 5.2.

2.4 System Development Process

The steps being followed in the development of the WIDB IT system design are generalized below:

1. Translation of previously derived functional and performance requirements into technical requirements and specifications
2. Development of high level operational concept, connectivity, and information exchange to support identified weather products/datasets and associated provider systems using suitable Web services, SOA components, and network-enabling technologies
3. Development of a guiding functional system level design for:
    a. Provider and consumer data exchange systems
    b. Intermediate and administration systems
    c. Data formats and protocols and associated service adapters
    d. Federated registry/repository
    e. Required security components.
4. Definition of system data flows and exchange
5. Definition of software, hardware, and communications component guidelines

6. Development of a high level transition plan and identification of associated issues and risks
7. Analysis of alternative design approaches

3 Reference Documents

The following documents were used in the preparation of the NOAA IT Design.

Document Name	Version	Date	Source
Concept of Operations for the Next Generation Air Transportation System	V2.0	6/13/2007	JPDO
NextGen Network-Enabled Weather IT CONOPS	3.2	8/20/2008	NCAR, MITLL, NOAA/GSD
NextGen ATS Enterprise Architecture	V2.0	6/22/2007	JPDO
Next Generation Air Transportation System Integrated Work Plan	V1.0	9/30/2008	On JPDO website
Next Generation Air Transportation System Integrated Plan			JPDO
Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management	0.1	1/18/2008	JPDO Functional Rqmts Study Team
Weather Concept of Operations	V1.0	5/13/2006	JPDO Weather Integrated Product Team
NextGen Weather Plan	0.6	3/20/2009	JPDO
List of IOC and FOC products that NWS has committed to provide for NextGen			JPDO EI Team
Final Performance Requirements (iFR) First Working Draft Wrapper - 4-D Weather Data Cube SAS	Draft	2/11/2009	JDPO
NextGen Business Case	V1.0	8/24/2007	JPDO
JPDO Information Management and Exchange Strategy	Draft	1/1/2008	JPDO
NextGen Weather Information Database - Information Technology Needs (Draft SON)	Draft	3/13/2009	OST
Concept of Operations and Operational Requirements - WIDB for the NextGen 07-042		5/4/2009	Office of Climate, Water and Weather Services
Definition of 4-D SAS		6/17/2009	NEWP presentation by JPDO Wx Policy Team2
ATM Wx Integration Plan	Draft V0.7	4/22/2009	JPDO
NextGen Network Enabled Weather Program 4-D Weather Cube White Paper	Ver 2.0	April 3, 2009	
4-Dimensional Weather Data Cube Web Feature Service Reference Implementation (WFSRI) Requirements	Ver 1.1	4/24/2009	GSD/NCAR/MITLL
4-Dimensional Weather Data Cube Web Coverage Service Reference Implementation (WCSRI) Requirements	Ver 1.1	3/23/3009	GSD/NCAR/MITLL

4-Dimensional Weather Data Cube Web Feature Service Reference Implementation (WFSRI) Architecture and Design	Ver 1.0	5/6/2009	GSD/NCAR/MITLL
4-Dimensional Weather Data Cube Web Coverage Service Reference Implementation (WCSRI) Architecture and Design	Ver 1.0	4/30/2009	GSD/NCAR/MITLL
NextGen Weather Data Flow and 4-D Weather Data Cube Service Adaptor Plan document	Draft	5/15/2009	FAA
FAA-developed IOC Product Flows worksheet			
NextGen Network-Enabled Weather Metadata Guidelines for the 4-D Weather Data Cube		4/24/2009	MITLL
NAS Architecture Roadmap	Ver 0.5	December 26, 2007	FAA
NAS Weather Functional Analysis Workgroup Report		August 30, 2004	FAA ATO
MITRE convection report			MITRE CAASD
WCS Implementation Standard	1.1.2	3/19/2008	OGC
WFS Implementation Specification	1.1.0	5/3/2005	OGC
Reference Architecture for Service Oriented Architecture	1	April 2008	OASIS
Reference Model for Service Oriented Architecture	1	October 2006	OASIS
NOAA Enterprise Architecture Technical Reference Model	1.0	9/1/2007	NOAA
ISE Enterprise Architecture Framework	2.0	September 2008	PM-ISE
DoD Architectural Framework (DODAF)	1.5	4/23/2007	DoD
Federal Enterprise Architectural Framework (FEAF)	1.1	September 1999	CIO Council
NAS Enterprise Architecture Framework (NASEAF)	2.0	9/30/2007	ATO AF WG
NWS Enterprise Architecture			
National Interchange Exchange Model (NIEM)			
PostgreSQL 8.4 documentation		7/1/2007	PostgreSQL
Federal Meteorological Handbook No.11 – Doppler Radar Meteorological Observations: Part C – WSR-88D Products and Algorithms		April 2006	OFCM
WCSRI Requirements	2.0	10/19/2009	GSD/NCAR/MIT LL
WFSRI Requirements	2.0	10/15/2009	GSD/NCAR/MIT LL
4D Weather Cube Single Authoritative Source (SAS) final performance requirements (fPR)	1.0	9/30/2009	FAA
NextGen NCO Concept of Operations	Pre-workshop draft	10/1/2009	JPDO

IRIS presentation	Workshop version	10/19/2009	Darone Jones

Note: 'Workshop' refers to the System-of-Systems workshops NWS held to kickoff NOAA systems involvement in the Cube.

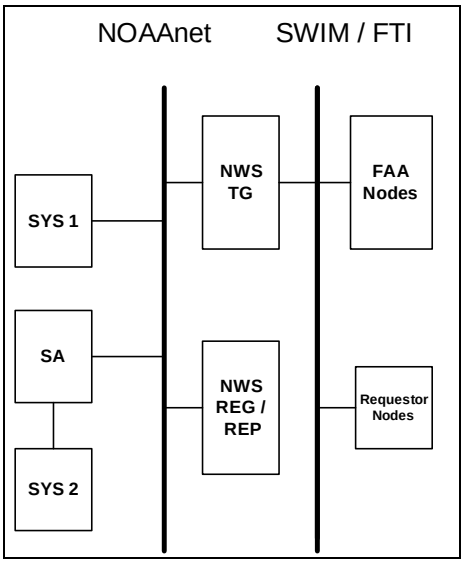
4 Architecture Summary

A companion document to this design document, the Weather Information Database (WIDB) Information Technology System Architecture Document, presents the basic architectural aspect on which the design is based. The sections that follow summarize this architecture.

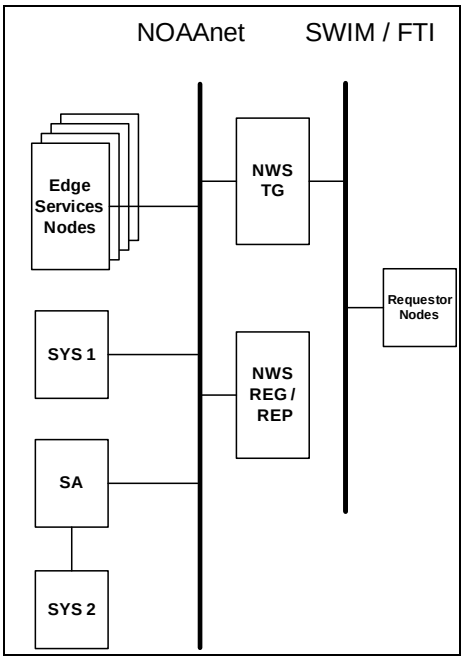
4.1 Architecture Options

Several architecture options are being considered.

The first target architecture option involves a relatively minimal development effort on the part of the NWS and is essentially a "status quo" approach. This minimal development option would implement a minimal amount of service adaption to accommodate format conversions from existing legacy provider systems and would accept data from new systems developed to provide data in the prescribed format for ingest into the Cube. The figure below illustrates the basic architecture of this minimal development approach.



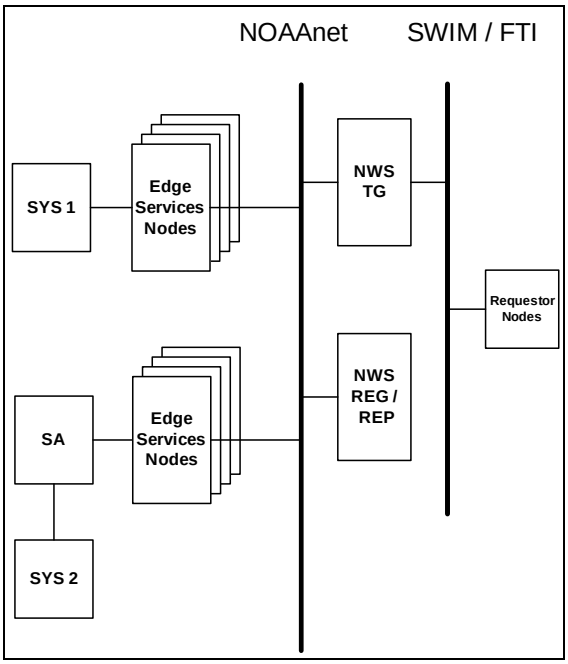
The second target architecture option would make use of centralized edge services nodes on the NOAA NWS side of the architecture to implement much of the functionality required to support the Cube. This approach would connect legacy systems through service adapters to NOAAnet and new systems directly through NOAAnet to the NWSTG as in the minimal development architecture, but would add edge services in a centralized configuration within NOAA NWS. These edge services nodes would then be able to accommodate much of the functionality not realized by NWS systems in the minimal development approach. Some of these functions could include data subsetting, management of subscription services, any further data processing required, data caching, system monitoring and reporting, security, and user access management.



The third architecture option is one that implements a “system of systems” approach. A system of systems is typically a fairly complex, highly distributed architecture that brings together numerous separate systems to meet a common set of information processing and distribution requirements. The system of systems approach will ideally net a large, loosely coupled set of systems that would have a greater functionality than the simple sum of the underlying parts.

For the NWS, this architecture approach would use numerous edge services nodes in a widely distributed fashion to implement the functional requirements of the NWS side of the Cube architecture. Data provider systems will be connected first into edge services that will more tightly manage interactions between providers and the other parts of the Cube architecture. There will still be legacy data provider systems that will require service adapters to perform required data format translations, however in this architecture that service adaptor functionality could reside in or near the edge services nodes.

The edge services will implement numerous services and/or modules to fulfill most if not all of the functional requirements. This architecture will be net-centric based on SOA principles and will be capable of accommodating interactions with the FAA WCS and WFS implementations. The architecture itself will be agile and scalable, allowing relatively easy changes to existing services and data products, as well as the addition of new data providers and data products.



The candidate solution will mostly likely incorporate aspects of mainly the third option, but centralized edge service nodes may be used on some cases when warranted.

4.2 Architecture Description

In line with the System of Systems approach, each candidate weather system included in the Cube will be treated as a separate node, either serving as a Wx Cube Data Source and offering data for use by Cube participants, or serving as a Wx Cube Data Destination, obtaining data from other Cube participants, or in some cases, serving as both. Data Sources will offer data to the Cube via Cube Input Edge Services (CIES), where Source Service Adaptors (SSA) will transform native or legacy source weather data into a format appropriate for ease of access by Cube participants. Data Destinations will initiate requests for Cube data and obtain Cube data via Cube Output Edge Services (COES), where Destination Service Adaptors (DSA) will transform weather back to format compatible with the destination system.

The CIES is composed of the following:

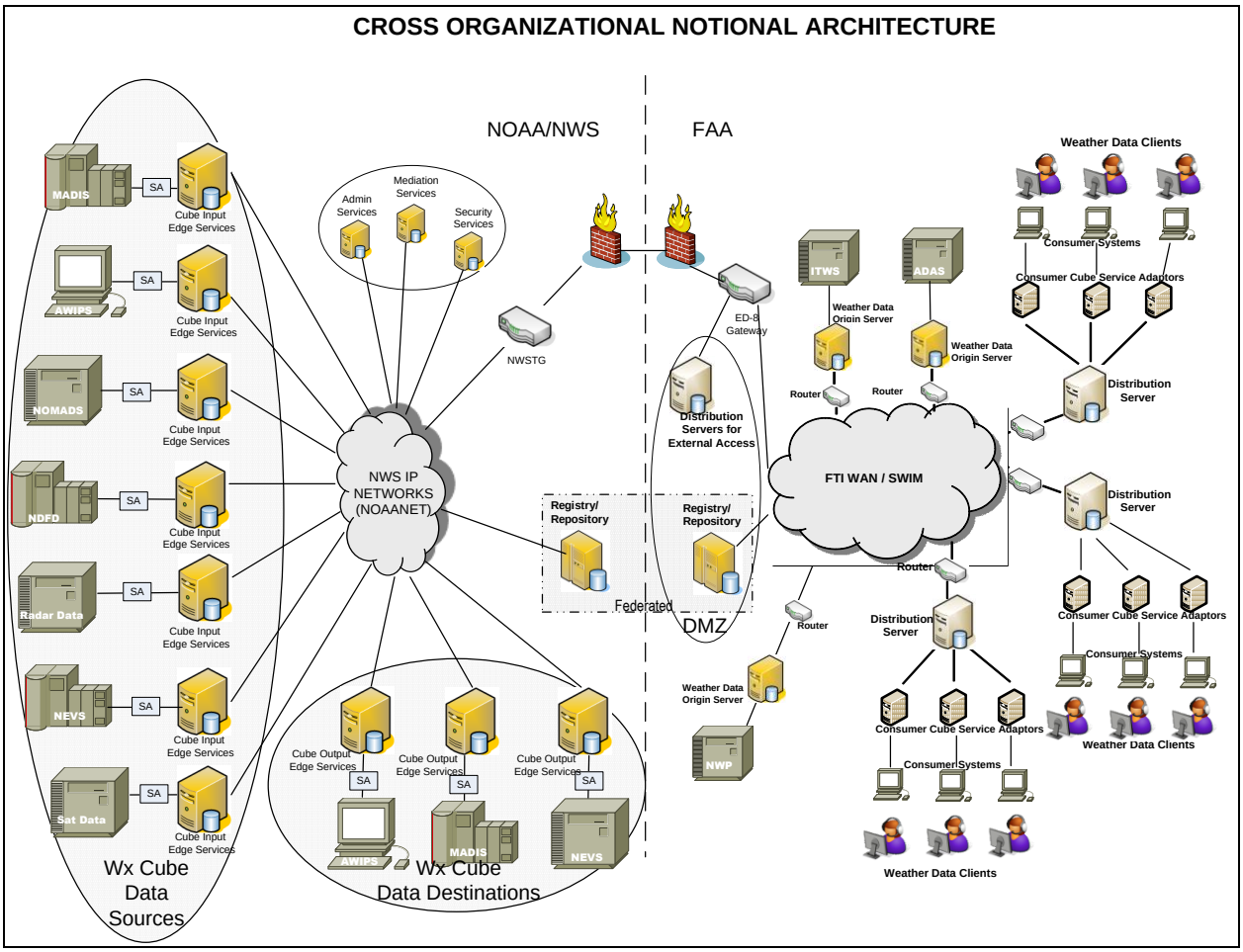
- System Ingest Adaptor – Provides an interface to the Wx Data Source System data and any required ingest processing
- CIES Processing / Storage – Performs the majority of processing required by the CIES, as well as the storage management
- Net-Enabled Interface – Supports the interface to the Cube, handling requests.

The COES is composed of the following:

- System Export Adaptor – Provides an interface to the Wx Data Destination System data and any required export processing
- COES Processing / Storage – Performs the majority of processing required by the COES, as well as the storage management
- Net-Enabled Interface – Supports the interface to the Cube, handling requests.

A variety of other services / components may be required to support Cube operations. Security Services will provide for the exchange / storage of security and trust related shared information (tokens, keys, etc) as well as security processing to include encryption, decryption, authentication, and boundary security. Security is intended to be provided on several levels, including: transport layer communications, application, message and data. Distributed (or possibly centralized) administrative functions will be necessary to control, operate, and monitor all the systems that comprise the Cube. These functions are intended to be provided via a series of web service-based Administrative Services. In order to allow for the interoperability between otherwise incompatible source (producer) and destination (consumer) systems, Mediation Services may be required to translate between incompatible data formats and / or incompatible data exchange protocols.

Additionally, the Registry/ Repository will also be a separate node and will be federated with other Registry/Repositories (e.g., the FAA Reg/Rep). These nodes will be net-enabled via appropriate Web-services, and be accessible via an IP-based communication infrastructure (NOAANET). This IP-based communications infrastructure will connect to the FAA portion of the Cube via appropriate boundary protection devices and security services. This will most likely be performed via connections from the NWSTG to various FAA ED-8 gateway locations. The figure below presents a cross-organization view of this notional architecture as it is currently envisioned.



Key aspects of the FAA architectural approach, as they relate to the NOAA Cube architecture, are addressed in the WIDB Information Technology System Architecture Document.

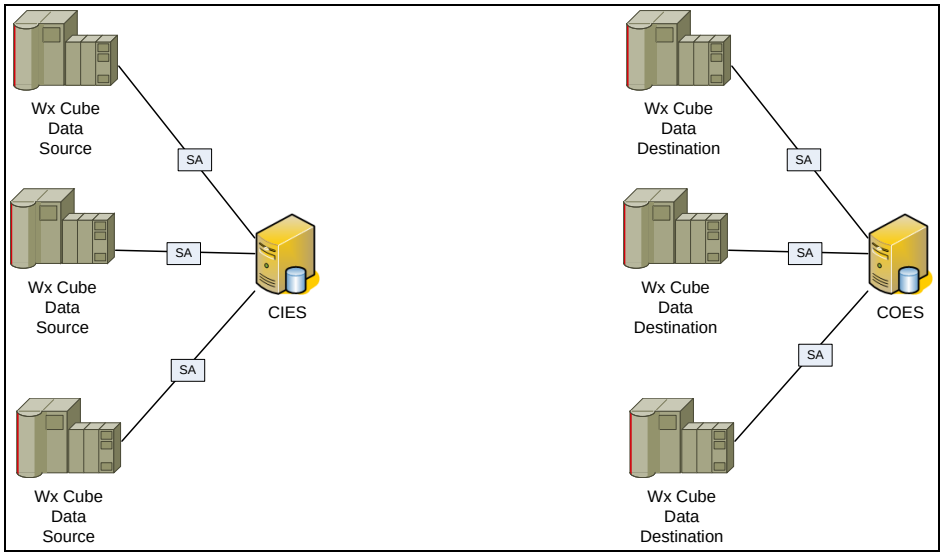
4.3 Alternative Architecture Configurations

Although the figure above shows each weather data system depicted and its respective interface component to the Cube (i.e., CIES and COES) as independent systems (i.e., NDFD is provided Cube access via a CIES to publish its data to the Cube) interfacing via a standalone Service Adaptor, a variety of alternative approaches are being considered which may be supported concurrently within the Cube.

4.3.1 Hybrid Distributed / Centralized CIES /COES Approach

While some Wx Data Source Systems might have their own dedicated CIES to support Cube access to their data, the NOAA architecture concept allows for the pooling of the CIES functionality for multiple Wx Data Source Systems into a single CIES in a more centralized fashion, as shown in the figure below. Similarly, pooling of COES functionality for multiple Wx Data Destination Systems into a single COES may be implemented. This may be necessary if a given data source or destination has not been net-enabled

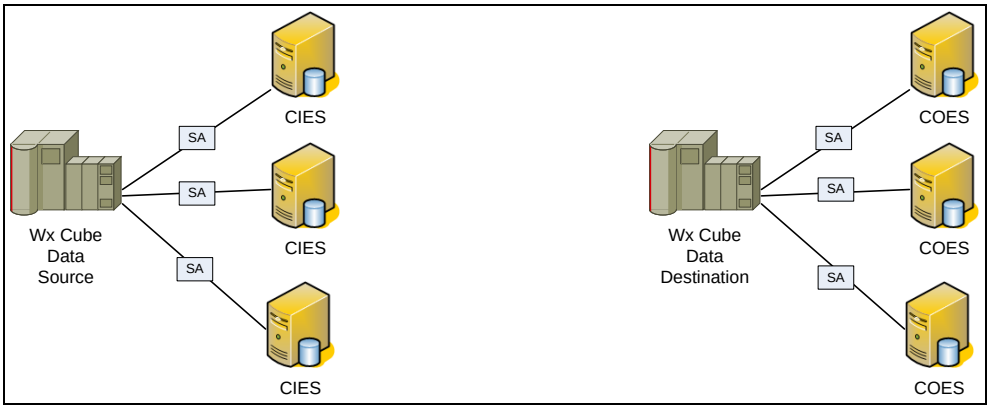
directly, or if demand on a single CIES or COES is so limited they are capable of handling access to multiple source or destination systems.



4.3.2 Redundant CIES / COES Approach

As the figure below depicts, to ensure unique (and in some cases, yet to be defined) performance metrics can be met, some Wx Data Source Systems may necessitate that multiple CIESs exist that are serving that source's data to the Cube. This may be required to ensure that if one CIES fails, a redundant CIES can immediately take over without any observed downtime. To ensure adequate site diversity, these multiple CIESs may need to be physically remote from one another. Alternatively, for load handling purposes, multiple CIES may be online constantly to lessen any impacts of degraded performance during peak load periods. Finally, in order to ensure guaranteed service to key data consumers, dedicated CIESs may be made available with access limited to certain data consumers or potential direct access via alternative, dedicated communications means.

Similarly, multiple COES may be necessary if a Wx Data Destination System requires it for any of the above mentioned performance reasons.



5 System Design

Appendix A provides the technical requirements / specification that have been derived for those systems associated with the NOAA portion of the NextGen 4-D Cube. The design that follows presents an approach to satisfy these requirements. As the requirements evolve and are refined, so too must the corresponding design.

This section presents the IT architecture system design for the Weather Information Database (WIDB) in a format that makes use of guidance provided by the Department of Defense Architecture Framework (DoDAF), specifically, DoDAF Version 1.5, Volume II: Product Descriptions. The DoDAF is a reference model to organize enterprise architectures (EA) and systems architectures into complementary and consistent views. It defines a set of products for visualizing and understanding the complexities of large architectures through graphic, tabular, and textual descriptions. For the WIDB IT architecture design, the DoDAF was chosen as a template due to its acceptance within the Federal Government and because it calls for an effective collection of representational products at an appropriate level of detail with a cohesive flow of presentation.

5.1 All View

This section provides information relating to overarching aspects of the WIDB architecture that relate to the subsequent Operational, Service, and Technical Views.

5.1.1 AV-1- Overview and Summary Information

Architecture Project Identification

- Name

The name of the subject architecture from the standpoint of the NOAA National Weather Service is the NextGen Architecture and Infrastructure Development of the Weather Information Database (WIDB) Information Technology System Architecture, or more simply, WIDB. This architecture is also known within the JPDO and the FAA as the NextGen 4-D Weather Cube, and the nomenclature of WIDB, the 4-D Weather Cube, and the Cube will be used interchangeably herein.

- Architect

The IT systems architect from NOAA NWS is the Systems Engineering Center (SEC) within the Office of Science and Technology (OST), which reports to the Office of the Assistant Administrator for Weather Services of the NWS.

- Organization Developing the Architecture

Overall, the governing organization developing the architecture is the JPDO with both NWS and FAA acting as the internal architecture developers and systems engineers for development of the IT system architectures that will be implemented within their respective organizations. This follows from the fact that NOAA NWS is developing the WIDB architecture within NOAA and FAA is developing the

complementary NextGen weather systems architecture within the FAA and that these two will interconnect to form the overall Cube system of systems architecture.

– Assumptions and Constraints

The following key assumptions are driving NOAA's NextGen IT Architecture. These assumptions include the following, which are detailed in the preceding document, the *WIDB IT System Architecture Document*:

- Use of a System of Systems approach
- Compatibility with key NOAA and NWS Enterprise Architecture guidance
- Compliance with NextGen requirements
- Supports IT ConOps Use Cases
- Compatible with evolving FAA Architecture
- Supportive of NextGen Enterprise Architecture definition of Business Services / Operational Activities

The *WIDB IT System Architecture Document* also documents numerous known and potential issues and risks that may represent programmatic and/or technical constraints.

Additional assumptions and constraints applied at the NextGen weather programmatic level are documented in JPDO reference documentation including the *NextGen Weather Plan* and the *Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management*.

– Approval Authority

Ultimately, the JPDO serves as the approval authority for the NextGen Air Transportation System and its component systems. However, there is an approval level associated with both NOAA NWS and the FAA for development and implementation of their respective subsystems related to the 4-D Weather Cube.

– Schedule

Currently, the program plan information available projects an initial capacity for the Cube to be implemented and serving weather data to end users in 2013. The *NextGen Weather Plan* describes goals for the Cube in 2013 such as establishing common data formats and exchange protocols, achieving network-enabled information exchange, and providing, at a minimum, aviation weather information for the following products:

- Turbulence
- Icing
- Convection
- Ceiling and visibility
- Winds (surface and aloft)

Beyond 2013, the next schedule milestone is to achieve an intermediate capacity in 2016 offering network compatibility of environmental information and direct integration of weather into Air Traffic Management Systems. Finally, the full operational capability in the 2022 timeframe will meet all NextGen weather requirements, will provide high resolution, nested scale forecasts for all elements, and

will achieve full network connectivity, ensuring consistent information availability and use across service areas and user groups.

– Level of Effort and Projected and Actual Costs to Develop the Architecture

The three design alternatives addressed in this document have varying levels of effort and costs associated with them. Appendix C – Alternate Approaches summarizes and compares the relative differences between the three designs considered and presents at a high level the required levels of effort and general costs. As this information becomes available in more detail, a summary of findings will be included here.

• Scope: Architecture View(s) and Products Identification

– Views and Products Developed

In following the DoDAF Version 1.5, Volume II: Product Descriptions, the scope of this document presents the Operational View, the Service View, and the Technical View of the WIDB architecture. The specific products developed herein are summarized by view below:

- Operational View
  - OV-1 High Level Operational Concept Graphic
  - OV-2 Operational Node Connectivity Description
  - OV-3 Operational Information Exchange Matrix
  - OV-4 Organizational Relationship Chart
- Service View
  - SV-1 Systems / Services Description
  - SV-2 Systems / Services Communications Description
  - SV-3 Systems to Systems Matrix
  - SV-4a Systems / Services Functionality Descriptions
  - SV-4b – System / Services Data Flows
  - SV-6 Systems Data Exchange Matrix (ICDs)
- Technical View
  - TV-1 Technical Standards Profiles

In addition to the above components called out in the DoDAF, this design specification document also addresses the following topics in subsequent individual sections or appendices:

- Additional design considerations
- Hardware and software component guidelines
- Transition plan
- Open issues / risks
- Itemized technical requirements / specifications
- Summary of alternative approaches

– Time Frames Addressed

The timeframe covered by the information presented in this document spans from roughly 2009 through 2025, which represents the full design, development, implementation, and commissioning cycle of the 4-D Weather Cube. This time period contains the primary milestones of initial, intermediate, and full capabilities as addressed in the previous section, Architecture Project Identification.

– Organizations Involved

As a fairly large scale system of systems, the Cube IT architecture will involve numerous organizations and communities of interest (COI). The high level organizations involved have been touched upon in the earlier section on Key Players and include as governing authority the JPDO, which is comprised of the DoD, DoC, DoT, DHS, NASA, and the White House Office of Science and Technology Policy.

Under these agencies, the primary organizations involved in the design, implementation, and operation of the Cube are NOAA NWS (DoC) and the FAA (DoT). Beyond these, there is a much larger group of organizations and COI's that will be involved directly with the Cube. These can be generally divided into organizations providing data into the Cube and those consuming data from the Cube, although some of these will act as both providers and consumers. An initial/partial listing these involved organizations is presented in the table below:

- Data Providers
  - NWS National Centers for Environmental Prediction
    - Aviation Weather Center
    - Storm Prediction Center
    - Tropical Prediction Center
    - Space Weather Prediction Center
  - ADDS
  - AWIPS
  - IOOS
  - MADIS
  - NCDC/NGDC
  - NCEP CCS and NOMADS
  - NDFD
  - NDE (NPP/NPOESS)
  - Verification Systems
    - NEVS
    - RTVS
    - Stats on Demand
  - Radar Data Server
  - GAS (GOES-R)
  - FAA Weather Systems
    - TDWR
    - ASOS
    - ITWS
    - COSPA
  - Airlines
- Data Consumers
  - Air Traffic Managers
  - Air Traffic Controllers (e.g., tower, TRACON, and en route)
  - Flight Planners (e.g., dispatcher and general aviation pilot)
  - Flight Briefers (e.g., flight service station controller)
  - Accident investigators (NTSB, DoD, FAA)
  - NOAA

  - Airlines
- Data Provider/Consumers
  - NWS Forecasting Systems
  - NWS Network Enabled Verification Service (NEVS)
  - Industry (airlines, weather data providers)
- Designers/Developers
  - OST (NWS)
  - FAA
  - NCAR
  - ESRL/GSD
  - Contract System Developers
- System Operators / Governance (NOAA & FAA)
  - Enterprise Service Managers
  - IT Maintenance Staff

• Purpose and Viewpoint

The purpose of the WIDB IT architecture is to meet the needs and requirements of aviation weather user communities for a single point of access for all relevant aviation weather required to perform their duties and to ensure safe and efficient operations within the National Airspace System (NAS) as well as on and around airports. Safe and efficient NextGen operations will be dependent on enhanced weather capabilities based on three major tenets[1]:

- A common picture of the weather for all transportation decision makers and aviations system users
- Weather integrated directly into sophisticated decision-support capabilities to assist decision makers
- Utilization of Internet-like information dissemination to realize flexible and cost-efficient access to all necessary weather information.

These requirements have been established by the JPDO as part of the larger NextGen Air Transportation System that will overhaul aviation operations and supporting services from virtually every aspect. This concept is referred to as “curb to curb,” as the NextGen program will affect nearly all operations involved in servicing air passengers, not just the weather related portion associated with the Cube.

A driving need for the Cube architecture to be implemented is the requirement for aviation weather users to have access to definitive weather information as input to key decision support tools. These various decision support tools include manual tools, automated tools, and hybrid manual-automated tools. The requirement for a definitive source for weather information, both forecasts and observations, will be met by the component within the Cube called the Single Authoritative Source (SAS). The SAS will make available a subset of products and datasets available in the Cube that has been vetted as the *best source* for that information for a given spatial and temporal range. This will eliminate varying, and

[1] Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management; JPDO, Version 0.1, January 18, 2008.

sometimes conflicting, information available to decision makers thereby increasing the confidence and effectiveness of their actions related to managing operations within the NAS.

Current analysis of the WIDB IT architecture, from the standpoint of this IT system design specification, is that of a systems engineering analysis. This analysis is being performed by the NWS OST Systems Engineering Center (SEC) in parallel with the FAA NNEW systems engineering support group. This analysis will support NOAA, the FAA, and the JPDO in making a decision on a specific architecture option, including such aspects as data products and sources, formats and protocols, registry/repository to support data discovery and access, subsystem and communications architectures, required security elements, and governance strategy.

As with any well designed system, the primary viewpoint from which the Cube IT architecture is being developed is that of the end user of the aviation weather data within the Cube. Emphasis is on delivering the required data in a timely manner through a process that can validate the data as the best available for a given space and time via the SAS. Other requirements are driving this customer viewpoint development such as meeting the needs for specific products using standards-based data formats and transport protocols. Another viewpoint that must be considered during the development of the WIDB IT architecture is that of the data providers, since a number of them do not currently conform to the standards that will be implemented by the Cube. Their viewpoint must be considered in order to practically plan for their participation, which will require various levels of effort and related subsystem implementation in order to adapt their products and datasets for ingestion and dissemination through the Cube. This viewpoint is also significant from a schedule perspective, as more fully developed provider systems using the same or similar standards as the Cube may be integrated into the system of systems more readily. Other viewpoints include those of the organizations that will be responsible for operations, governance, and maintenance of the Cube. The architecture design will be influenced by how those responsibilities can be most efficiently supported.

• **Context**

The WIDB IT architecture is being developed in the context of the organizational, programmatic, and functional environment for the 4-D Weather Cube laid out by the JPDO in its working documents including the NextGen Concept of Operations (ConOps) v2.0, the initial Integrated Work Plan, the Enterprise Architecture (EA) v2.0, and the Weather ConOps v1.0. As previously referenced, the mission, goals, and vision of the NextGen 4-D Weather Cube are to provide a single, network-enabled access point for a common weather picture for aviation weather users and decision makers, and for input into various decision support tools, to realize more flexible, cost-effective, and safe operations of the NAS.

Conventions followed in development of the Cube IT architecture are generally those regarded in the industry as systems engineering best practices. For this project, this approach involves the following activities:

- Collection of functional and performance requirements from users and their representative organizations
- Assessment of existing systems and interfaces
- Preliminary architecture design

- Identification of data source and data consumer systems and users
- Identification of standards-based data formats and transfer protocols
- Support for CONOPS and Use Case development
- Coordination with constituent organizations for identification of security requirements
- Development of technical specifications from previous steps
- Analysis of alternative architectures
- Development of a recommended architecture design

NOAA, FAA, and ultimately the JPDO are the governing authorities for rules, criteria, and conventions employed for the development and implementation of the Cube.

The Cube IT architecture will be heavily reliant and therefore closely linked to other information architectures. The two primary architectures fitting this category are NOAA's NOAAnet Enterprise Architecture and the FAA's System Wide Information Management (SWIM) system and the supporting FAA Telecommunications Infrastructure (FTI). As will be seen in later sections detailing the design, these IT architectures will form the backbone of Cube related communications within and between NOAA and the FAA. NOAAnet is currently comprised of a major carrier-provided, national MPLS network and now connects numerous NWS line offices including, but not limited to, the WFOs, RFCs, and the Consolidated Internet Farms (CIF). NOAAnet is the basic transport element supporting the NOAA and the NWS Enterprise Architecture. The FAA's SWIM is currently under development and will be the Enterprise Architecture for data exchange within the FAA. SWIM is being developed as a Service Oriented Architecture (SOA) running on top of the FTI transport component, which is a national IP-based WAN taking advantage of the strengths of multiple service providers through a contract with a single large communications integrator.

• **Findings**

The WIDB IT architecture effort is in the early stages of defining a design to meet requirements identified to date. Once the project has matured sufficiently, and the design has been circulated among various stakeholders for review and concurrence, it will be possible to conduct further analyses regarding findings and recommendations related to architecture implementation. Once these analyses and the resultant findings are available, this document will be revised to include relevant information.

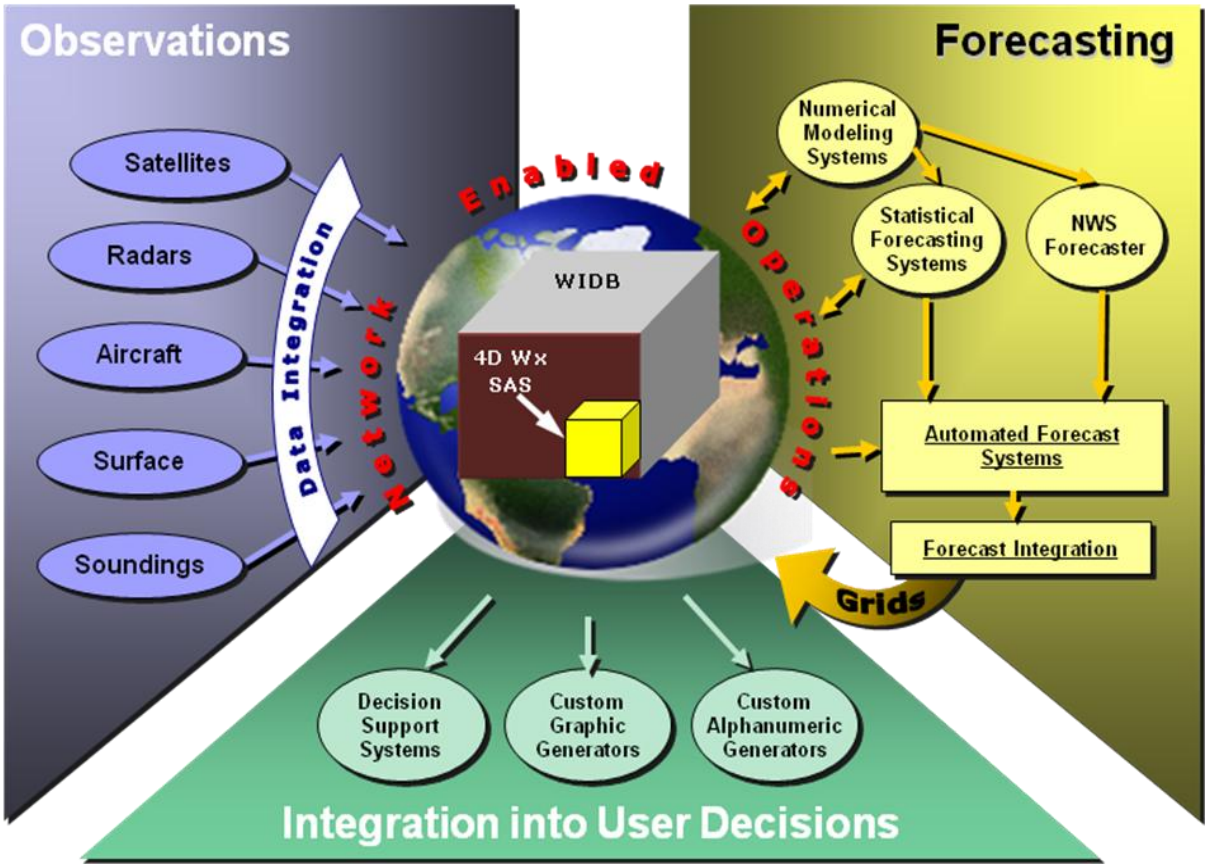
5.2 Operational View

This section provides the operational view of the WIDB IT architecture. The OV describes the tasks and activities, operational elements, and information exchanges required for operations of the architecture. This section includes the following products from the DoDAF:

- OV-1 High Level Operational Concept Graphic
- OV-2 Operational Node Connectivity Description
- OV-3 Operational Information Exchange Matrix
- OV-4 Organizational Relationship Charts

5.2.1 OV-1 High Level Operational Concept Graphic

The high level operational concept of the WIDB 4-D Weather Cube is shown in the figure below.[2] The graphic represents WIDB within a layer of network enabled operations that will be realized using a Service Oriented Architecture (SOA). The primary operations supporting the Cube, and that the Cube supports, will be manifested by numerous operational nodes that fulfill data provider and data consumer roles including observations, forecasting, and use of data in decision making processes.



Observations of aviation related weather from various sources are integrated through network enable operations into the Cube, where data integration will include processing of required temporal and spatial subsetting and format conversion as required to deliver data in the standard formats support by the Cube. Observations are supplied by data providers using input edge services that are described later.

Forecasting is done by numerous offices and centers in NOAA and that will act as both data consumer and data provider nodes, as many of these organizations will receive data from the Cube for input into forecasting tools and will subsequently return many of their output products back into the Cube for

[2] *NextGen 101 and The Weather Information Database* presentation; Steve Abelman, Aviation Meteorology Focal Point, NWS Office of Science and Technology

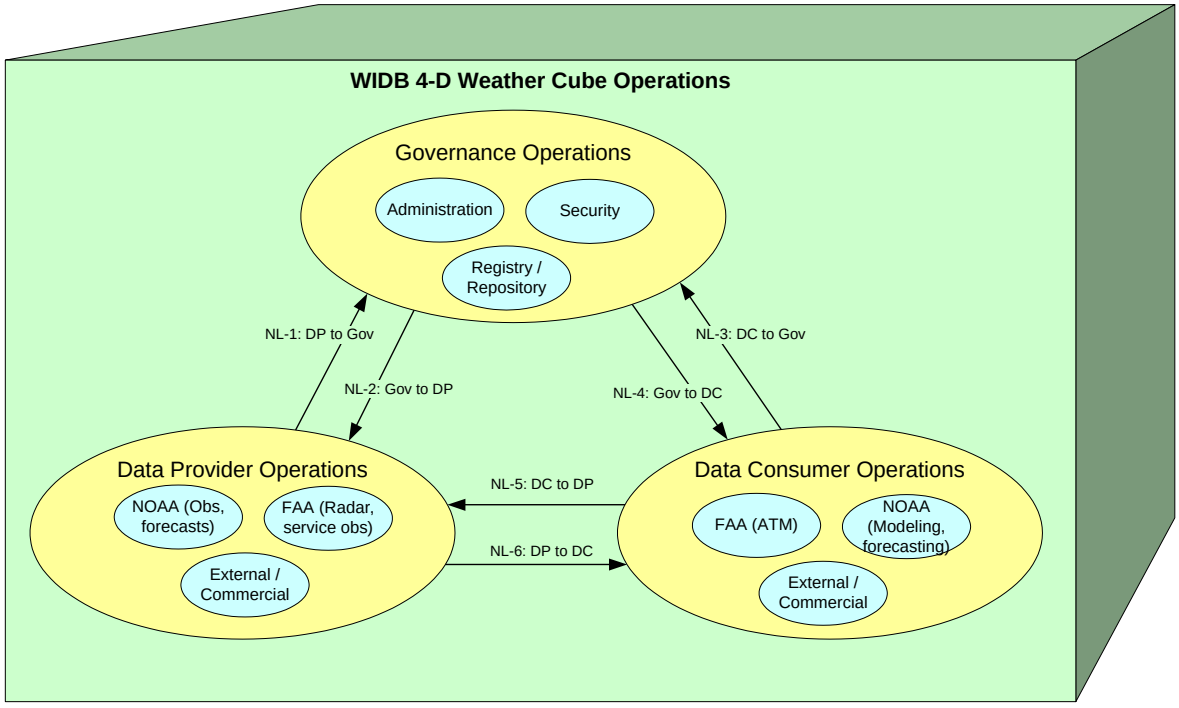
other users to access.-Forecasting entities will interact with the Cube using input edge services and output edge services described later. Forecasting is done with both automated tools and modeling applications as well as by highly trained NOAA and NWS personnel. The forecasts will be integrated through the SOA based edge services and returned into the Cube for consumption by other end users.

Integration of data from the Cube into user decision support tools represents support for the primary group of data consumers. The decision support systems node will consist of numerous aviation weather data consumer systems. The Cube will offer these users a single point of access to aviation weather within the Cube. Much of the data offered to these end users will be available through the 4-D Weather Single Authoritative Source (SAS), which will comprise aviation weather that has been certified as the best source for a given product within a particular temporal and spatial domain.

Cube operations represented are anticipated to consist of both pull (ad hoc requests) of data and push (subscription / publication) of data to support end user needs. These operations will rely on a federated registry / repository for data discovery and subscription management. The majority of operations will be via machine-to-machine interactions, i.e., they will be automated. Machine-to-machine operations will generally consist of delivery of predefined data from providers to consumers through the Cube SOA services. A certain amount of operations will be manual through the use of Graphical User Interfaces (GIU), such as ad hoc data requests, setting up new data services, setting up subscriptions, and many of the administrative and security operations. Underlying Cube operations will be supported by the IT architecture that will consist of a "virtual" repository of data with no single physical database or computer. Conceptually, the Cube will be a unified source of data distributed among multiple physical locations and suppliers, of which NOAA is the leading data supplier. IT architecture operations of the Cube will be highly scalable in order to accommodate numerous new and unanticipated users, both from the provider standpoint and the consumer standpoint.

5.2.2 OV-2 Operational Node Connectivity Description

This section presents a view of the WIDB IT architecture that focuses on operational nodes and required information exchange. The figure below shows this view of the operational nodes and the "needlines" between them that represent the high level information flow between them. The figure shows three major operational nodes: governance, data providers, and data consumers. Within each, there are several lower level operational nodes that will each be served by the needlines connecting the major operational nodes. The information exchange between nodes associated with the needlines (identified as NL-1 through NL-6) is further decomposed in Section 5.2.3 covering OV-3. It should be noted that this representation does not indicate network or physical connectivity, rather that particular operational nodes need information made available by other operational nodes.



Within the three major operational nodes shown there are lower level nodes that consist of numerous elements of the IT operational architecture that produce, consume, and/or process information. These lower level nodes are presented in the information exchange matrix in the next section covering OV-3.

5.2.3 OV-3 Operational Information Exchange Matrix

This section expands on the OV-2 operational node connectivity concept by mapping information exchange to the needlines and operational nodes presented in OV-2. An information exchange is composed of a needline and information element(s). OV-3 identifies information types and associates these to the producing and consuming operational nodes and presents this information in an information exchange matrix. It is intended to capture important aspects of selected information exchanges. This starts with the following descriptions of the needlines shown in the figure above. These descriptions give a high level list of the information type that is transferred along each line and are referenced using a needline number, e.g., NL-1, as in the figure, with the following abbreviations: Gov = Governance, DP = Data Provider, and DC = Data Consumer.

NL-1; DP to Gov: Service info, such as inventory of products, info on network access to products (URL, IP address, server info), data formats; validity of datasets, user authorization level for Source access if required; metadata about datasets available; service provider credentials; notification of newly available datasets for ad hoc request and for subscription fulfillment;

NL-2; Gov to DP: Administrative info (maintenance activities, storage info performance statistics, QOS); acknowledgement of receipt of service info and metadata; subscribe user info; data format requirements

NL-3; DC to Gov: User info; security/authorization info for restricted datasets; subscription info (add, modify, cancel); metadata requests (discovery); service info requests

NL-4; Gov to DC: Response to metadata requests; response to service info requests; acknowledgement of changes to subscriptions (add, modify, cancel); notification of updated datasets for subscription fulfillment; information exchange error notification;

NL-5; DC to DP: Ad hoc data requests (pull) with associated subsetting and formatting parameters; user credentials, security/authorization info

NL-6; DP to DC: Weather data (response to ad hoc requests, fulfillment of subscription requests); data exchange error notifications

Other fields included in the information exchange matrix presented below are as follows:

- **Source Operational Node:** Organization, office, or center that produces particular data elements
- **Source Organization:** The Government, commercial, or other organization to which the source node belongs
- **Consumer Operational Nodes:** Organizations, offices, and/or centers that consume particular data elements from the identified source node through the relevant needline. There will typically be several consumer nodes per source node/needline, as the source to consumer relationship is often one-to-many at the level described here
- **Consumer Organization:** The Government, commercial, or other organization to which the consumer node belongs
- **Information Type:** General description of the information exchange type

Needline	Source Organization	Source Operational Node	Consumer Organization	Consumer Operational Nodes	Information Type
NL-1: DP to Gov	NOAA NWS	NCEP (AWC, TPC, SPC, SWPC), NWSTG/TOC, ESRL/GSD, NCDC, etc.	NOAA NWS	WIDB Governance Operations	Admin Info, Service Info, Metadata, Authorization / Security Requirements,
	FAA	TDWR (ITWS), etc.	NOAA NWS	WIDB Governance Operations	Admin Info, Service Info, Metadata, Authorization / Security Requirements,
	External / Commercial	Airlines, Lightning Data Provider, IOOS	NOAA NWS	WIDB Governance Operations	Admin Info, Service Info, Metadata, Authorization / Security Requirements,
NL-2: Gov to DP	NOAA NWS	WIDB Governance Operations	NOAA NWS	NCEP, NWSTG/TOC, ESRL/GSD, NCDC, etc.	Admin Info, Subscription Info, Performance / QOS Info, Service & Metadata Acknowledgement, Mediation Info
	NOAA NWS	WIDB Governance Operations	FAA	TDWR (ITWS), etc.	Admin Info, Subscription Info, Performance / QOS Info, Service & Metadata Acknowledgement, Mediation Info

Needline	Source Organization	Source Operational Node	Consumer Organization	Consumer Operational Nodes	Information Type
	NOAA NWS	WIDB Governance Operations	External / Commercial	Airlines, Lightning Data Provider, IOOS	Admin Info, Subscription Info, Performance / QOS Info, Service & Metadata Acknowledgement, Mediation Info
NL-3: DC to Gov	FAA	ARTCC, TRACON, FSS/AFSS, ATCSCC, ATCT, TFMS	NOAA NWS	WIDB Governance Operations	Subscription Add / Mod / Delete, Service / Metadata Requests, Transport / Mediation Info, Authentication Credentials, User & Admin Data, Performance / QOS Info
	NOAA NWS	NOAA Modeling & Forecasting Systems	NOAA NWS	WIDB Governance Operations	Subscription Add / Mod / Delete, Service / Metadata Requests, Transport / Mediation Info, Authentication Credentials, User & Admin Data, Performance / QOS Info
	External / Commercial	Airlines, Pilots, Accident Investigators	NOAA NWS	WIDB Governance Operations	Subscription Add / Mod / Delete, Service / Metadata Requests, Transport / Mediation Info, Authentication Credentials, User & Admin Data, Performance / QOS Info

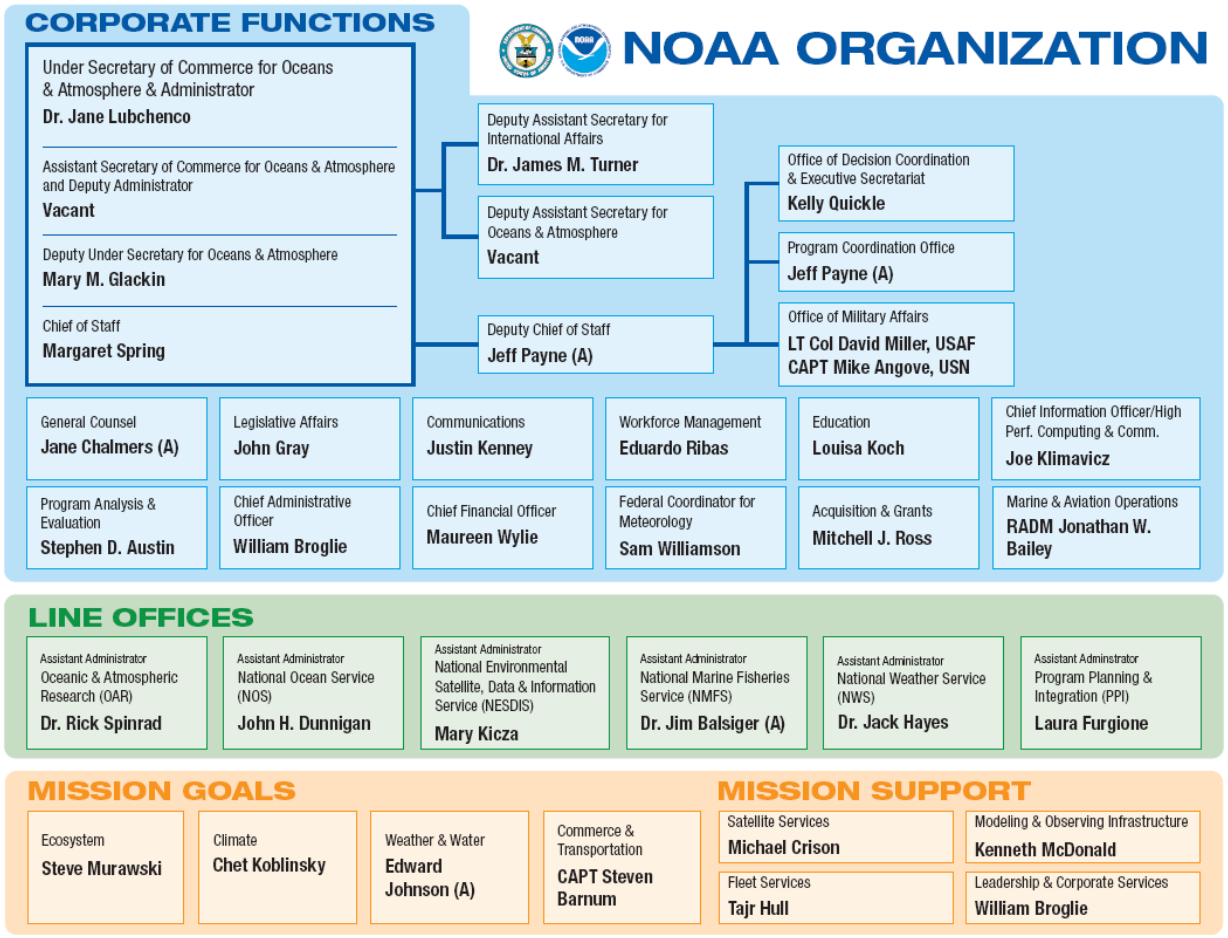
Needline	Source Organization	Source Operational Node	Consumer Organization	Consumer Operational Nodes	Information Type
NL-4: Gov to DC	NOAA NWS	WIDB Governance Operations	FAA	ARTCC, TRACON, FSS/AFSS, ATCSCC, ATCT, TFMS	Service / Metadata Response, Subscription Acknowledgement / Fulfillment Availability, Authentication Requirements / Response, Error Messages, Admin Info
	NOAA NWS	WIDB Governance Operations	NOAA NWS	NOAA Modeling & Forecasting Systems	Service / Metadata Response, Subscription Acknowledgement / Fulfillment Availability, Authentication Requirements / Response, Error Messages, Admin Info
	NOAA NWS	WIDB Governance Operations	External / Commercial	Airlines, Pilots, Accident Investigators	Service / Metadata Response, Subscription Acknowledgement / Fulfillment Availability, Authentication Requirements / Response, Error Messages, Admin Info
NL-5: DC to DP	FAA	ARTCC, TRACON, FSS/AFSS, ATCSCC, ATCT, TFMS	NOAA NWS	NCEP (AWC, TPC, SPC, SWPC), NWSTG/TOC, ESRL/GSD, NCDC, etc.	Ad Hoc Data Requests & Subsetting Parameters, Data Transport & Formatting Info, Security / Authorization Info

Needline	Source Organization	Source Operational Node	Consumer Organization	Consumer Operational Nodes	Information Type
	NOAA NWS	NOAA Modeling & Forecasting Systems	NOAA NWS	NCEP, NWSTG/TOC, NCDC	Ad Hoc Data Requests & Subsetting Parameters, Data Transport & Formatting Info, Security / Authorization Info
	FAA	ARTCC, TRACON, FSS/AFSS, ATCSCC, ATCT, TFMS	External / Commercial	Airlines, Lightning Data Provider, IOOS	Ad Hoc Data Requests & Subsetting Parameters, Data Transport & Formatting Info, Security / Authorization Info
	NOAA NWS	NOAA Modeling & Forecasting Systems	External / Commercial	Airlines, Lightning Data Provider, IOOS	Ad Hoc Data Requests & Subsetting Parameters, Data Transport & Formatting Info, Security / Authorization Info
	External / Commercial	Airlines, Pilots	NOAA NWS	NCEP (AWC, TPC, SPC, SWPC), NWSTG/TOC, ESRL/GSD, NCDC, etc.	Ad Hoc Data Requests & Subsetting Parameters, Data Transport & Formatting Info, Security / Authorization Info
	External / Commercial	Airlines, Pilots	FAA	TDWR (ITWS), etc.	Ad Hoc Data Requests & Subsetting Parameters, Data Transport & Formatting Info, Security / Authorization Info

Needline	Source Organization	Source Operational Node	Consumer Organization	Consumer Operational Nodes	Information Type
NL-6: DP to DC	NOAA NWS	NCEP, NWSTG/TOC, ESRL/GSD, NCDC, etc.	FAA	ARTCC, TRACON, FSS/AFSS, ATCSCC, ATCT, TFMS	Weather Observations & Forecasts (Satellite imagery, NEXRAD, text forecasts & products)
	NOAA NWS	NCEP, NWSTG/TOC, ESRL/GSD, NCDC, etc.	NOAA NWS	NOAA Modeling & Forecasting Systems	Weather Observations & Forecasts (Satellite imagery, NEXRAD)
	NOAA NWS	NCEP, NWSTG/TOC, ESRL/GSD, NCDC, etc.	External / Commercial	Airlines, Pilots, Accident Investigators	Weather Observations & Forecasts (Satellite imagery, NEXRAD, text forecasts & products)
	FAA	TDWR (ITWS), etc.	NOAA NWS	NCEP, NWSTG/TOC, NCDC	Radar Data, Observations
	FAA	TDWR (ITWS), etc.	External / Commercial	Airlines, Pilots, Accident Investigators	Radar Data, Observations
	External / Commercial	Airlines, Lightning Data Provider, IOOS	FAA	ARTCC, TRACON, FSS/AFSS, ATCSCC, ATCT, TFMS	Observations, Pilot Reports, Lightning Data
	External / Commercial	Airlines, Lightning Data Provider, IOOS	NOAA NWS	NCEP, NWSTG/TOC, NCDC	Observations, Lightning Data

5.2.4 OV-4 Organizational Relationship Chart

NOAA:



NWS:

To be supplied.

FAA:

To be supplied.

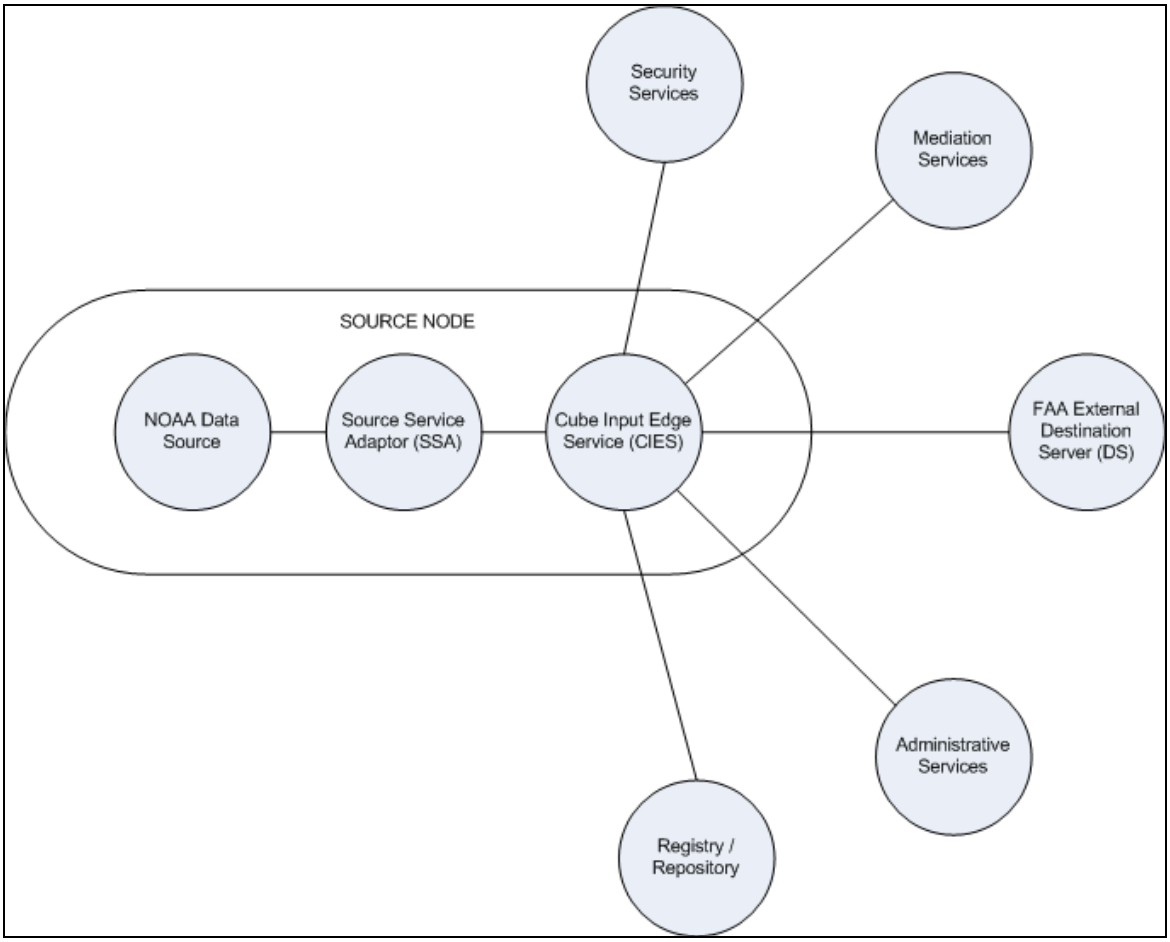
5.3 Systems and Services View

5.3.1 SV-1 Systems / Services Description

The DoDAF SV-1 model is used to depict the systems present at operational nodes, and the interfaces between nodes and systems. The following sections present provider side and consumer side nodes of NOAA's portion Cube. The provider side shows data entering the Cube and the systems that the process requires. Likewise, the consumer side shows which systems are needed to obtain data from the Cube.

5.3.1.1 Provider Side

Services and systems related to the NOAA provider side of the Cube are presented in the figure below.



The physical interface between the Source Node and Security Services, FAA External DS, Administrative Services, Mediation Services, and Registry/Repository nodes is provided by the NOAANet/FTI physical backbone.

NOAA Data Source: A system that provides data to the Cube. This system can be a legacy system with a SSA and CIES attached (as depicted above), or it can be a new system with that extra functionality required to net-enable its data for Cube use built-in.

Source Service Adaptor (SSA): At a high-level, the SSA takes data from the NOAA Data Source data and adapts it for input into the CIES. This involves any transformation of native data formats resident in the legacy system to a format that is supported by the CIES.

Cube Input Edge Services (CIES): Ingests weather data to the Cube. The CIES has processing and storage capabilities. In addition, the CIES net-enables the NOAA Data Source data via web-services such as WFS, WCS, WMS and JMBL.

Security Services: At this point, a portion of the Security functionality of the provider side is envisioned to be outside the source node, being accessed by many services in an SOA sense. In this manner, all players in the overall system-of-systems have access to these shared security functions . Another option is having all security functionality built-in the CIES.

Registry/Repository (Reg/Rep): In the system-of-systems, service-oriented architecture paradigm, the reg/rep acts as the catalog for all the locations of services available on the network. Services are used to obtain, subset, essentially perform various logic on data. The repository holds service metadata, and the registry holds service locations (network addresses: URL/URN/URI).

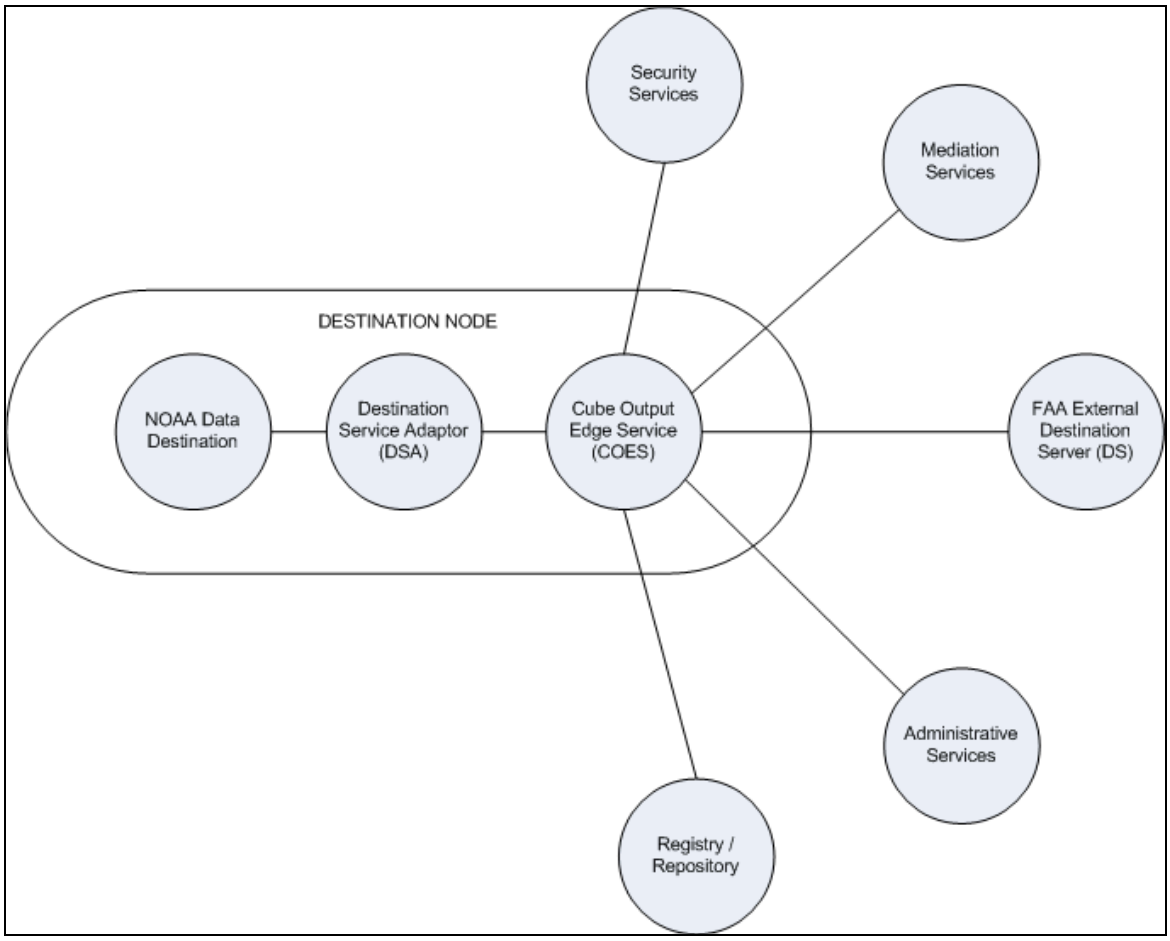
Mediation Services: To accommodate the different web services being used in the Cube, mediation services are used to translate a message from one web service format to another or translate one data format to another. It is presented in the design as being outside the node so that all systems can utilize the same set of mediation services.

Administrative Services: These services play an important role in propagating and enforcing a governance model throughout the network, as well as allowing for centralized or remote management of Cube components.

FAA External Destination Server (DS): This server (or set of servers) acts as a pass-through to the FAA's portion of the Cube. All requests from the FAA side for NOAA data, gets routed to this DS.

5.3.1.2 Consumer Side

Services and systems related to the NOAA consumer side of the Cube are presented in the figure below.



Likewise to the source node, the interface between the destination node and Security, Mediation Services, FAA External DS, Administrative Services, and Registry/Repository is provided by the NOAANet/FTI physical backbone.

NOAA Data Destination: This system uses Cube data as its input. Similar to the NOAA Data Source, the Data Destination can be fully integrated with NextGen technologies, or it can utilize a DSA/COES to obtain data from the Cube.

Destination Service Adaptor (DSA): Initiates requests for Cube data and transforms weather data from a format appropriate for easy access by the COES into a native format compatible with the NOAA Data Destination system.

Cube Output Edge Services (COES): Provides for the request and retrieval of Cube data from remote WCS/WFS/other web services, performs the necessary processing and local storage, and allows access to the data by the requesting Data Destination system.

Security Services: Refer to previous section.

Registry/Repository: Refer to previous section.

Mediation Services: Refer to previous section.

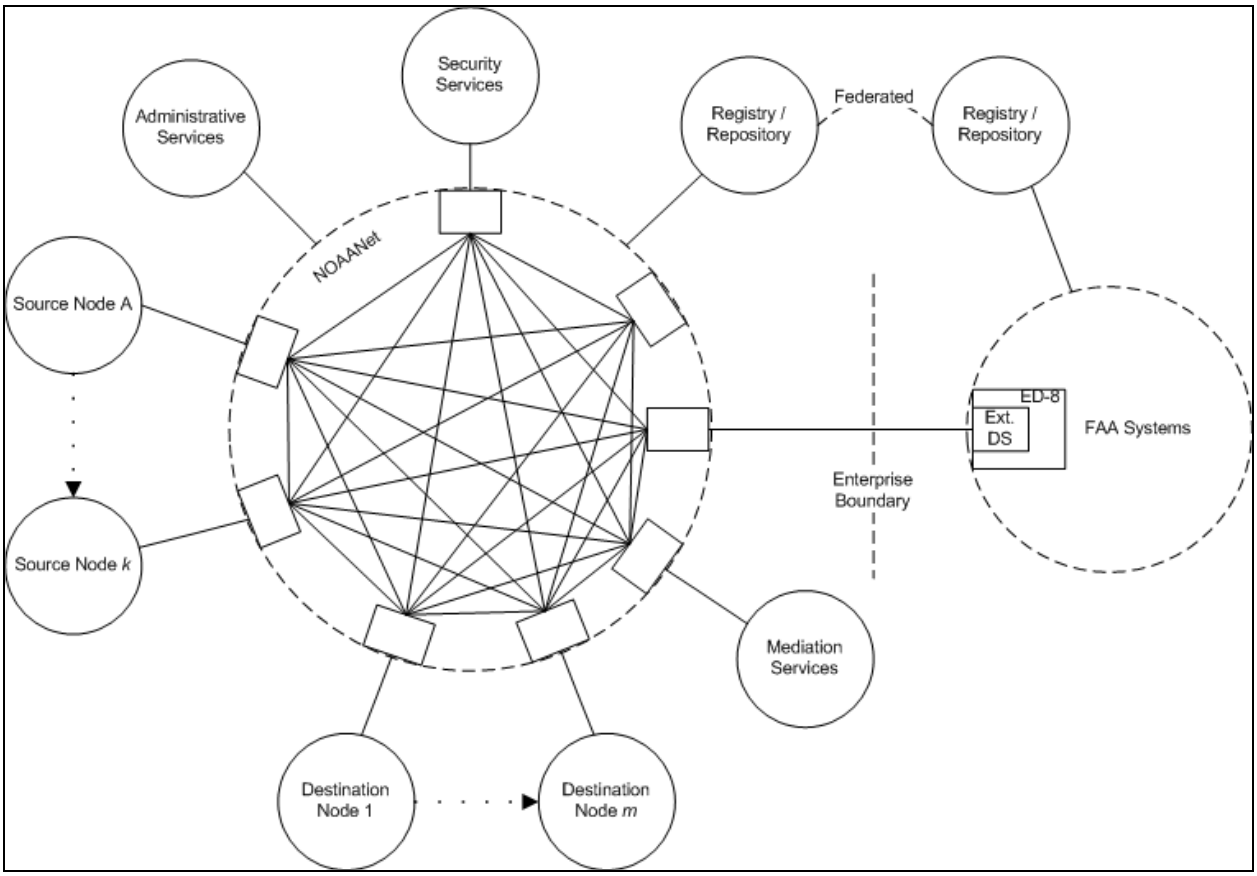
Administrative Services: Refer to previous section.

FAA External Destination Server (DS): Refer to previous section.

5.3.2 SV-2 Systems / Services Communications Description

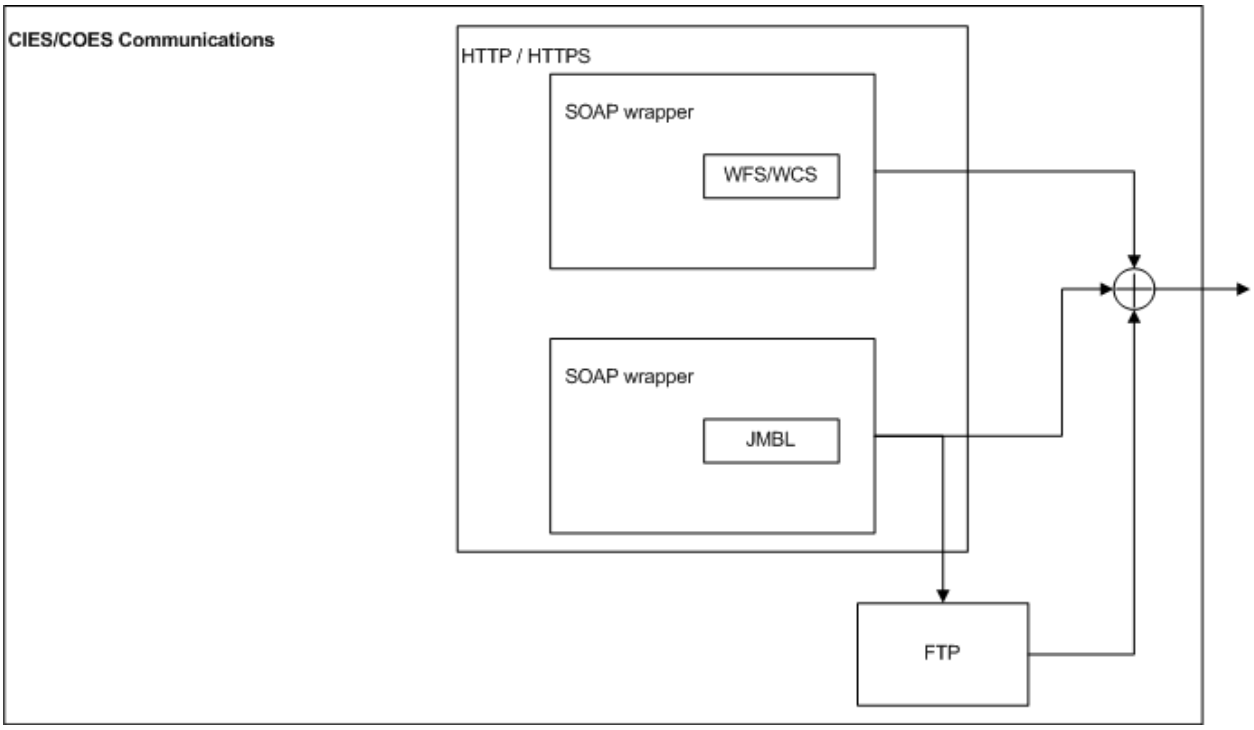
SV-2 provides insight on the communication paths used by the interfaces between systems, and system nodes. It identifies the communication systems that support the delivery of data/products to participating parties in the Cube and handles all other communication exchanges.

The diagram below depicts 'Source Node A' to 'Source Node *k*' having a connection, and corresponding interface to the NOAANet Multiprotocol Label Switching (MPLS) backbone. Likewise, 'Destination Node 1' to 'Destination Node *m*', 'Security Services', 'Mediation Services', 'Administrative Services' and 'Registry/Repository' are connected via the NOAANet backbone. The interface between NOAA systems and FAA systems is achieved by a NOAANet/FTI connection. The connection will be supported between several ED-8 gateways (FAA's external connection to the rest of the world) and most likely the NWSTG (not depicted in the diagram below). Additionally, physical boundary security devices will likely be required to appropriately segment NOAANet from FTI. In some cases, direct access to or from a CIES/COES may be provided to ensure specific performance requirements can be met, and in such cases NOAANet may not be the most appropriate communication path.



The SSA and DSA have communication links unique to each source and destination system, respectively. Both the DSA and SSA will likely have direct connections to the system they are responsible for network-enabling. To ensure compatibility, the communication link between each SA and its supporting source / destination system will be determined by the system owner.

The CIES/COES likely have two communication exchange protocols: HTTP(S)/FTP. HTTP(S) is used to send WFS/WCS/WMS/JMBL SOAP messages with optional data attachments over the NOAANet/FTI network. If the data request is made using JMBL and the data attachment is larger than a certain threshold value, an FTP exchange is required (as stated in the JMBL specification). The diagram below depicts the communication portion of the CIES/COES.



(5.3.3) SYSTEMS – SYSTEMS MATRIX (SV-3)

The SV-3 depicts the interfaces between systems presented in SV-1. The matrix below shows which systems introduced in SV-1 interact with each other. Each cell represents interaction between the associated row and column system.

	NOAA Source System	SSA	CIES	NOAA Destination System	DSA	COES	Reg/ Rep	FAA External DS	Security Services	Mediation Services	Admin Services
NOAA Source System		♦									
SSA	♦		●								
CIES		●	■			■	■	■	■	■	■
NOAA Destination System					♦						

DSA				♦		●				
COES			■		●	■	■	■	■	■	■
Reg/Rep			■			■		■	■		
FAA External DS			■			■					
Security Services			■			■					
Mediation Services			■			■		■			
Admin Services			■			■					

Below is a key to interpret the above table.

♦ - custom interface
● - custom or web service interface
■ - NOAANet interface connection

A custom interface is a connection that has to be determined during the detailed design and implementation process. Custom interfaces will exist between service adaptors and NOAA source/destination systems. The service adaptor/edge services will communicate through a web service interface (other standards based interface like FTP) or via a custom interface (only where required). All other communication interfaces will utilize standardized web services over the NOAANet network.

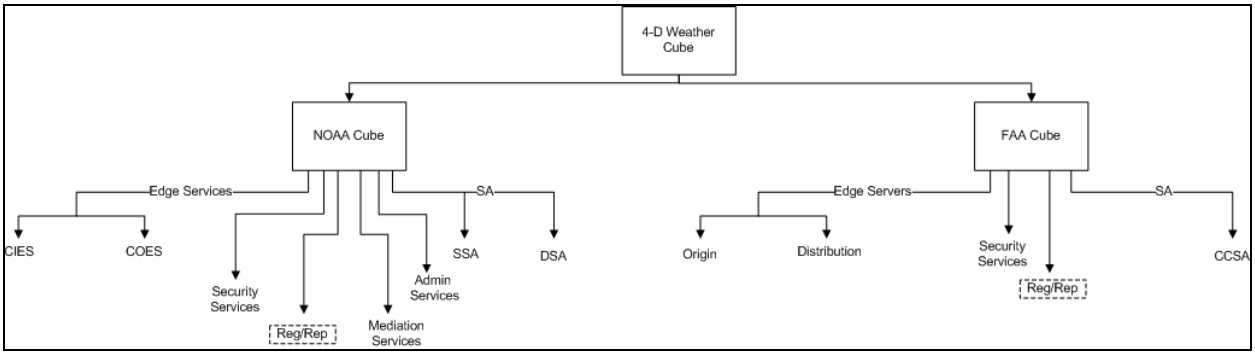
The interfaces presented in the chart above are functional interfaces: meaning that the interface between two associated systems does not have to be physical hardware, but rather they exist functionally. This is best seen by the following example. If a NOAA Source System is built with NextGen standards embedded in its design: the SSA may not physically exist, but rather the NOAA Source System performs the functions of the SSA and is connected directly to its associated CIES.

5.3.3 SV-4a Systems / Services Functionality Descriptions

SV-4 shows system functional hierarchies, system functions, and the system data flows between them.

5.3.3.1 Cube Level

SV-4a is used to depict the components that comprise the 4-D Weather Cube. The Cube level breakdown is presented in the figure below.



This diagram depicts the 4-D Weather Cube is composed by NOAA's and FAA's portions of the Cube. At a high level, NOAA's Cube is comprised by Edge Services, Service Adaptors, Security Services, Mediation Services, Administrative Services, and the Reg/Rep. Edge Services are either CIES or COES, each having functionality required to exchange data via network-enabled Cube interfaces. It is assumed that the Security Services within NOAA and FAA may be different to meet their unique requirements and policies each organization has established; however, the end-to-end security between NOAA and FAA systems is interoperable. The Reg/Rep is depicted with a dashed border to indicate the federation between NOAA's and FAA's respective Reg/Rep. NOAA Mediation Services are shown to conform to JMBL and WFSRI/WCSRI requests and responses. For example, a gridded data request given in JMBL from a NOAA CIES would be translated to its WCS equivalent in order to communicate with FAA Cube component systems. The FAA Cube may also contain various mediation services, as well. The Administrative Services allow for the management and configuration of many internal CIES/COES functions, etc.

Components specific to the FAA portion of the Cube are described in more detail in the IT Architecture document.

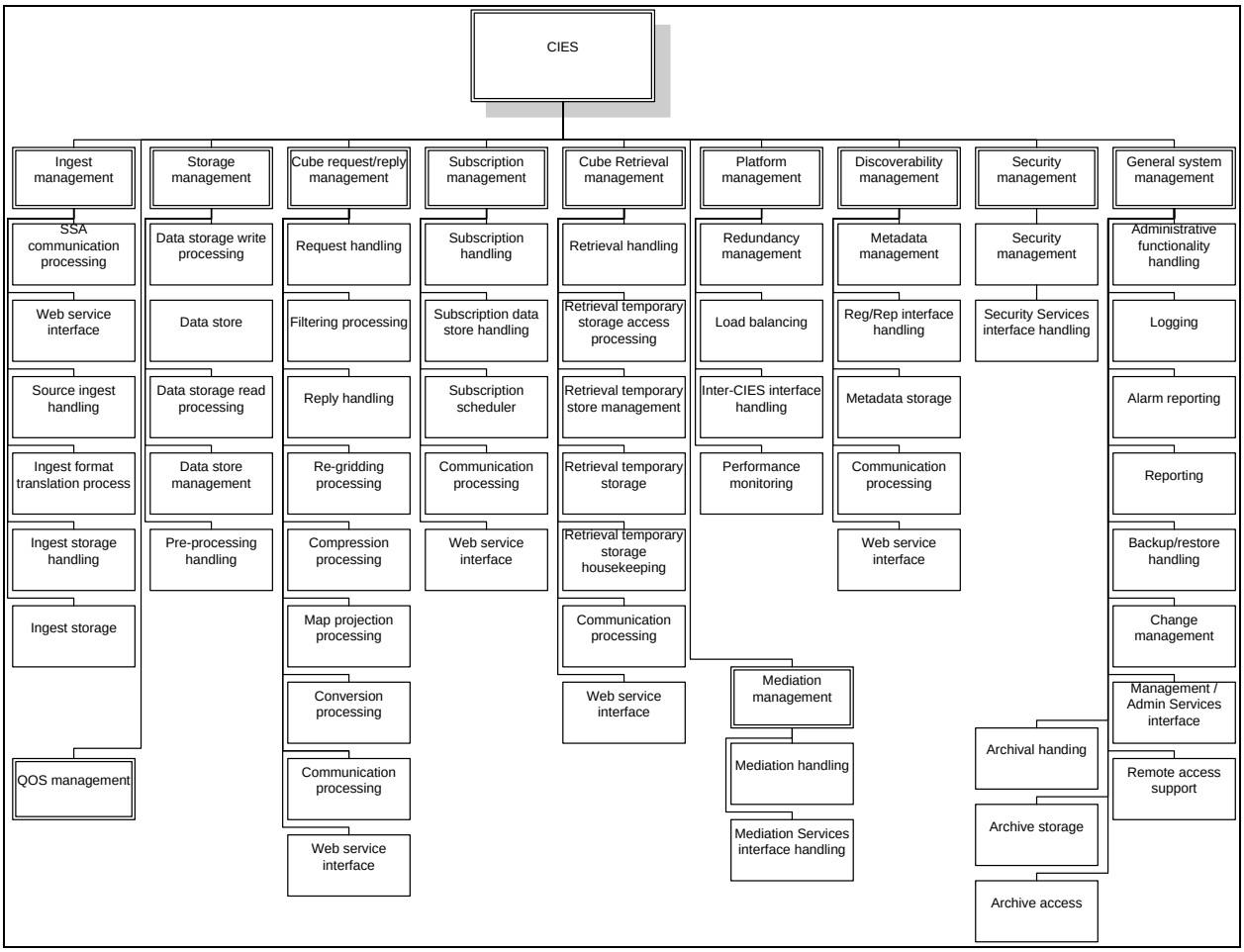
5.3.3.2 System level

5.3.3.2.1 CIES

This section presents the functional components that comprise the CIES design. A subsequent section addresses the flow of information between the various functional components of the CIES and various external entities.

The figure below presents these eleven key functional components and the specific detailed functionality associated with each. The eleven components are:

- Ingest management
- Storage management
- Cube request/reply management
- Subscription management
- Cube retrieval management
- Platform management
- Discoverability management
- Security management
- Mediation management
- QOS management
- General system management



The following sections present in more detail the specific detailed functionality supported by the CIES.

5.3.3.2.1.1 Ingest Management

Details associated with the functionality of the CIES Ingest Management function are presented below.

SSA communication processing

- Handles physical / transport layer communication between CIES and multiple SSAs
- Handles transport layer security between CIES and each SSA
- Provides communication means for SSA to push data to CIES
- Provides communication means for CIES to read and pull data from SSA

Web service interface

- Provides Web Service support for delivery of data from SSA to CIES
- Provides WFS-Transaction-Update interface for feature data delivery to CIES
- Provides mechanism for SSA to notify CIES of data availability
- Handles application layer security between SSA and CIES

Source ingest handling

- Processes data received from SSA and manages its subsequent storage and any translation prior to storage
- Processes notification from SSA that data is available for retrieval from the SSA
- Processes notification from SSA that data from SSA is available in CIES ingest storage
- Logs arrival of data from SSA
- Performs security processing to data / messaging from SSA

Ingest format translation process

- Performs request format translation from ingested format into CIES storage format

Ingest storage handling

- Retrieves available data from SSA upon notification by SSA and temporarily stores it
- Retrieves data from temporary ingest storage placed there by SSA
- Logs arrival of data from SSA
- Performs security processing to data from SSA
- Manages any translation of data prior to storage for Cube access
- Manage delivery of ingested data to the CIES Cube data store

Ingest storage

- Provides temporary storage of SSA ingested data prior to the data being made available to the CIES Cube data store

5.3.3.2.1.2 Storage Management

Details associated with the functionality of the CIES Storage Management function are presented below.

Data storage write processing

- Receives ingested (and pre-processed) data and writes it to the primary CIES data store
- Provides an indication of when refreshed data destined for subscription distribution is received

Data store

- Provides storage of all Cube-available data

Data storage read processing

- Handles all requests for access to data in the CIES data store
- Queries and retrieves desired data from data store
- Manages the formatting of data store queries based on desired filtering / subsetting
- Provides requested data from data store for delivery in the resultant reply
- Provides error results from failed data store queries

- Manages and initiates requests for the pre-processing of some commonly requested data (pre-processing may include filtering / subsetting / translations / re-gridding)

Data store management

- Retrieves data from data store destined for extended archiving
- Performs housekeeping on data store contents (to include purging stale data) based on configuration information
- Provides data to archiving process

Pre-processing handling

- Performs pre-processing to perform some commonly requested actions (pre-processing may include filtering / subsetting / translations / re-gridding)
- Provides pre-processed data for storage

5.3.3.2.1.3 Cube Request/Reply Management

Details associated with the functionality of the CIES Cube Request/Reply Management function are presented below.

Request handling

- Receives current platform loading information on which to base load-balancing decisions
- Receives and processes re-requests from overloaded CIESs
- Re-routes requests to underloaded CIES
- Receives and processes adhoc requests for data, and subscription related requests (request to be added to a subscription service, or modify or delete an subscription)
- Coordinates subscription related requests / notifications with subscription management task
- Handles requests for data for subscription distribution based on subscription data availability
- Initiates request to data store for required data
- Passes request to filtering process to initiate required filtering
- Coordinates any data or request format mediation
- Applies QOS metrics to determine order of processing of requests
- Applies required security functions to requests (eg. verify requestor, decrypt data, etc)
- Provides error indication of faulty received request
- Log activities

Filtering processing

- Translates Cube request into specific filter / subsetting parameters

Reply handling

- Generates reply to include requested data, notification that subscription data is available for request, notification that data is available for retrieval or that an error was encountered
- Initiates any required pre-delivery processing (compression, re-gridding, conversion, map – reprojection)
- Handles returning error replies
- Provides data to temporary storage for subsequent retrieval
- Coordinates any data or reply format mediation
- Applies QOS metrics to determine order of processing of replies
- Applies required security functions to replies
- Logs activities

Re-gridding processing

- Performs any re-gridding of requested data prior to delivery

Compression processing

- Performs any compression of requested data prior to delivery

Map projection processing

- Performs any map projection processing of requested data prior to delivery

Conversion processing

- Performs any format / units of measurements conversion of requested data prior to delivery

Communication processing

- Handles physical / transport layer communication between Cube entities and CIES
- Handles transport layer security between Cube entities and CIES
- Handles transport layer QOS support between Cube entities and CIES

Web service interface

- Provides Web Service support for all communications between Cube entities and CIES
- Translates Web Service formatted requests / replies into internal CIES communication formats
- Handles application layer security between Cube entities and CIES

5.3.3.2.1.4 Subscription Management

Details associated with the functionality of the CIES Subscription Management function are presented below.

Subscription handling

- Allows for the definition, modification and cancellation of subscription services

- Translates subscription service definitions into appropriate data store query requests
- Delivers subscription service update information (availability, cancellation, modification)
- Processes requests for participation in established subscription services
- Processes modification and cancellations of requests participation in established subscription services
- Upon receipt of notification of refreshed subscription data availability, initiates data store query and data delivery
- Manages subscription data delivery scheduling set-up
- Upon notification of scheduled delivery time for subscription data, initiates data store query and data delivery
- Manages QOS metrics to determine order of processing of requests
- Applies required security functions to requests / replies
- Logs activities

Subscription data store handling

- Registers details of each subscription service with data storage
- Handles notification from data storage the refreshed subscription data is available

Subscription scheduler

- Performs scheduling of periodic subscription data delivery based on pre-defined set-up

Communication processing

- Handles physical / transport layer communication between CIES and Cube entities
- Handles transport layer security between CIES and Cube entities
- Handles transport layer QOS support between CIES and Cube entities

Web service interface

- Provides Web Service support for all communications between Cube entities and CIES
- Translates internal CIES communication formats to Web Service formatted replies
- Handles application layer security between CIES and Cube entities

5.3.3.2.1.5 Cube Retrieval Management

Details associated with the functionality of the CIES Cube Retrieval Management function are presented below.

Retrieval handling

- Processes requests to retrieve temporarily stored data
- Manages retrieval and delivery process of stored data or resulting errors in handling request
- Coordinates any data or reply format mediation

- Manages QOS metrics to determine order of processing of requests
- Applies required security functions to requests / replies
- Logs activities

Retrieval temporary storage access processing

- Handles requests to retrieval data and performs data retrieval from temporary data store
- Provides retrieved data for delivery

Retrieval temporary store management

- Receives and manages storage of data destined for temporary storage
- Logs activities

Retrieval temporary storage

- Serves as the temporary storage repository for data awaiting retrieval

Retrieval temporary storage housekeeping

- Performs housekeeping of temporary data storage based on administrative configuration information
- Logs activities

Communication processing

- Handles physical / transport layer communication between Cube entities and CIES
- Handles transport layer security between Cube entities and CIES
- Handles transport layer QOS support between Cube entities and CIES

Web service interface

- Provides Web Service support for all communications between Cube entities and CIES
- Translates Web Service formatted requests / replies into internal CIES communication formats
- Handles application layer security between Cube entities and CIES

5.3.3.2.1.6 Platform Management

Details associated with the functionality of the CIES Platform Management function are presented below.

Redundancy management

- Performs processing to ensure those CIESs configured to serve as redundant peers stay in sync

Load balancing

- Assesses loading statuses using information from external CIES, as well as internal performance

- Processes rerouted requests due to load balancing processing
- Provides real-time service availability information to be used for service discovery purposes

Inter-CIES interface handling

- Handles all communications between CIES serving as redundant or load balancing peers

Performance monitoring

- Performs self monitoring of health and operational performance
- Provides current health status for use with QOS management, load balancing processing and administrative monitoring / reporting

5.3.3.2.1.7 Discoverability Management

Details associated with the functionality of the CIES Discoverability Management function are presented below.

Metadata management

- Obtains and stores metadata
- Converts real-time service availability information into metadata updates
- Processes request for metadata from Cube entities
- Obtains requested metadata from metadata storage
- Delivers requested metadata
- Initiates activities to synchronize CIES and Reg/Rep metadata

Reg/Rep interface handling

- Performs interface processing required to ensure CIES metadata is consistent with that stored in the Reg/Rep

Metadata storage

- Serves as storage location for all CIES metadata

Communication processing

- Handles physical / transport layer communication between Cube entities and CIES
- Handles transport layer security between Cube entities and CIES

Web service interface

- Provides Web Service support for all communications between Cube entities and CIES
- Translates Web Service formatted requests / replies into internal CIES communication formats
- Handles application layer security between Cube entities and CIES

5.3.3.2.1.8 Security Management

Details associated with the functionality of the CIES Security Management function are presented below.

Security management

- Converts security requirements into security controls
- Provides security control information for internal CIES processing
- Coordinates all security aspects with external Security Services (user authentication, key exchanges, etc)
- Logs security activities

Security Services interface handling

- Manages the communications between any external Security Services

5.3.3.2.1.9 Mediation Management

Details associated with the functionality of the CIES Mediation Management function are presented below.

Mediation handling

- Provides mediation support to translate incompatible requests and responses

Mediation Service interface handling

- Serves as communication conduit to external Mediation Service instances which perform required translations / mediation

5.3.3.2.1.10 QOS Management

Details associated with the functionality of the CIES QOS Management function are presented below.

QOS management

- Monitors and reports on real-time platform performance statistics
- Provides QOS control based on configuration details
- Provide QOS control information to various tasks to ensure key services / users get required service quality

5.3.3.2.1.11 General System Management

Details associated with the functionality of the CIES General System Management function are presented below.

Administrative functionality handling

- Allows for the establishment of what data pre-processing should take place
- Allows for entry of metadata
- Allows for the definition of subscription services to be supported
- Allows for the configuration of the various storage housekeeping functions
- Allows for configuration of security information
- Allows for the configuration and control of QOS functionality

Logging

- Consolidates logging from all CIES processes for administrative access

Alarm reporting

- Consolidates alarms for reporting for administrative access

Reporting

- Consolidates reporting info for administrative access

Backup/restore handling

- Manages functions associated with backing up and restoring CIES

Change management

- Provides functionality to allow for the addition of new services, interface types and data.

Management / Admin Services interface

- Provide interface for human access to administrative functionality
- Provides secure access to administrative functions

Remote access support

- Provides interface for remote access to administrative functionality

Archival handling

- Receives data for archival storage
- Performs data store housekeeping / purging
- Stores archived data into archival storage

Archival storage

- Serves as location for archival storage

Archive access

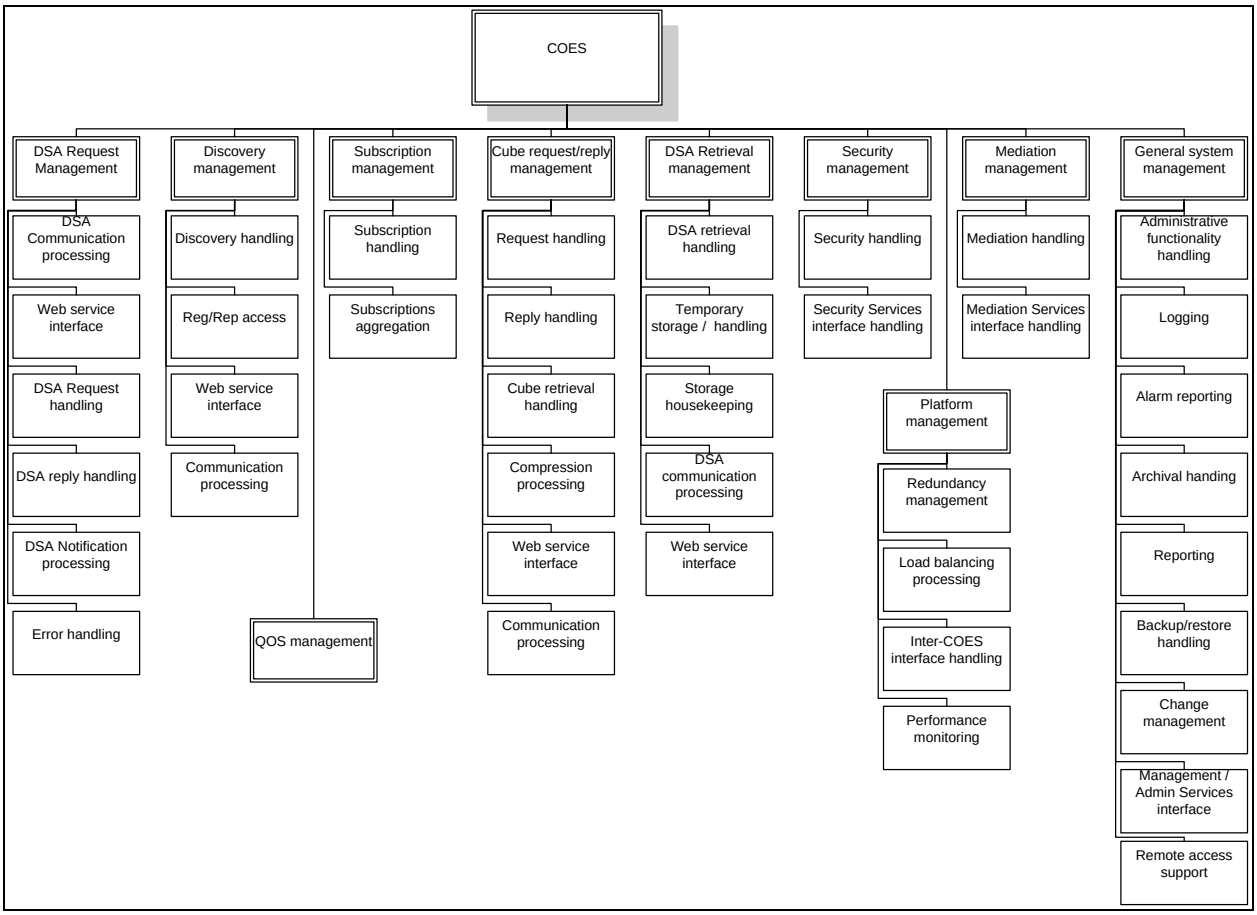
- Allows for access to archival storage

5.3.3.2.2 COES

This section presents the functional components that comprise the COES design. A subsequent section addresses the flow of information between the various functional components of the COES and various external entities.

The figure below presents these ten key functional components and the specific detailed functionality associated with each. The ten components are:

- DSA request management
- Discovery management
- QOS management
- Subscription management
- Cube request/reply management
- DSA retrieval management
- Security management
- Platform management
- Mediation management
- General system management



The following sections present in more detail the specific detailed functionality supported by the COES.

5.3.3.2.2.1 DSA Request Management

Details associated with the functionality of the COES DSA Request Management function are presented below.

DSA communication processing

- Handles physical / transport layer communication between COES and multiple DSAs
- Handles transport layer security between COES and each DSA
- Provides communication means for DSA to request data from the COES
- Provides communication means for COES to return data and or the DSA to pull data from the COES

Web service interface

- Provides Web Service support for the request of data from the COES by the DSA
- Provides mechanism for COES to notify DSA of data availability
- Handles application layer security between DSA and COES

DSA request handling

- Processes a request for data from the DSA
- Generates an error reply if DSA request is faulty
- Initiates a query to locate the desired data source (via Reg/Rep query)
- Processes query reply from Reg/Rep response
- Receives current platform loading information on which to base load-balancing decisions
- Receives and processes re-requests from overloaded COESs
- Re-routes requests to underloaded COES
- Translates Reg/Rep query reply into appropriate data or subscription request
- Applies QOS metrics to determine order of processing of requests
- Applies required security functions to requests
- Logs activities

DSA reply handling

- Receives and processes replies from previous requests
- Initiates sending of reply to requesting DSA
- Applies QOS metrics to determine order of processing of replies
- Applies required security functions to requests
- Logs activities

DSA notification processing

- Receives and processes notifications received from previous requests
- Performs initiation of retrieval of data from source and places retrieved data into temporary storage
- Initiates sending of notification to requesting DSA upon receipt of retrieved data
- Applies QOS metrics to determine order of processing of replies
- Applies required security functions to requests
- Logs activities

Error handling

- Delivers error replies to the DSA

5.3.3.2.2.2 Discovery Management

Details associated with the functionality of the COES Discovery Management function are presented below.

Discovery handling

- Processes requests for queries to and replies from the Reg/Rep.

Reg/Rep access

- Performs interface processing required to access metadata that is stored in the Reg/Rep

Web service interface

- Provides Web Service support for all communications between COES and the Reg/Rep
- Translates Web Service formatted requests / replies into internal COES communication formats
- Handles application layer security between COES and the Reg/Rep

Communication processing

- Handles physical / transport layer communication between COES and the Reg/Rep
- Handles transport layer security between COES and the Reg/Rep

5.3.3.2.2.3 QOS Management

Details associated with the functionality of the COES QOS Management function are presented below.

QOS management

- Monitors and reports on real-time platform performance statistics
- Provides QOS control based on configuration details
- Provide QOS control information to various tasks to ensure key services / users get required service quality

5.3.3.2.2.4 Subscription Management

Details associated with the functionality of the COES Subscription Management function are presented below.

Subscription handling

- Receives and processes requests from DSA for subscriptions (additions, modifications, cancellations)
- Receives and processes notifications of changes to established subscription services
- Notifies administrative functions of subscription services changes
- Supports disaggregation of received subscription data
- Applies QOS metrics to determine order of processing of replies
- Applies required security functions to requests
- Logs activities

Subscriptions aggregation

- Determines and combines duplicative subscription requests into single request

5.3.3.2.2.5 Cube Request/Reply Management

Details associated with the functionality of the COES Cube Request/Reply Management function are presented below.

Request handling

- Processes requests for data and subscription access for Cube delivery
- Coordinates any data or request format mediation
- Applies QOS metrics to determine order of processing of requests
- Applies required security functions to requests
- Logs activities

Reply handling

- Processes reply of data or notifications of data availability
- Initiates uncompressing received data
- Processes replies, errors, or received subscription data for delivery to DSA
- Coordinates any disaggregation of received subscription data
- Processes and delivers notifications of changes to established subscription services
- Coordinates any data or reply format mediation
- Applies QOS metrics to determine order of processing of replies
- Applies required security functions to replies (eg. verify source, decrypt data, etc)
- Logs activities / archive responses

Cube retrieval handling

- Initiates retrieval of data from source indicated in notification
- Processes retrieved data and makes it available for temporary storage
- Coordinates any retrieval request or data format mediation
- Initiates notification upon receipt of retrieved data
- Initiates uncompressing retrieved data
- Applies QOS metrics to determine order of processing of replies
- Applies required security functions to replies (eg. verify source, decrypt data, etc)
- Logs activities / archive responses

Compression processing

- Performs uncompressing processing

Communication processing

- Handles physical / transport layer communication between COES and Cube entities
- Handles transport layer security between COES and Cube entities
- Handles transport layer QOS support between COES and Cube entities

Web service interface

- Provides Web Service support for all communications between Cube entities and COES
- Translates Web Service formatted requests / replies into internal COES communication formats
- Handles application layer security between Cube entities and COES

5.3.3.2.2.6 DSA Retrieval Management

Details associated with the functionality of the COES DSA Retrieval Management function are presented below.

DSA retrieval handling

- Processes requests from DSA to retrieve data
- Queries temporary storage for requested data
- Returns requested data to the requesting DSA
- Logs activities

Temporary storage / handling

- Stores retrieved data
- Provides requested retrieved data upon request

Storage housekeeping

- Performs housekeeping (purging) of temporary storage based on administrative configuration

DSA communication processing

- Handles physical / transport layer communication between COES and multiple DSAs
- Handles transport layer security between COES and each DSA
- Provides communication means for DSA to request data from the COES
- Provides communication means for COES to return data and or the DSA to pull data from the COES

Web service interface

- Provides Web Service support for the request of data from the COES by the DSA
- Provides mechanism for COES to notify DSA of data availability
- Handles application layer security between DSA and COES

5.3.3.2.2.7 Security Management

Details associated with the functionality of the COES Security Management function are presented below.

Security management

- Converts security requirements into security controls
- Provides security control information for internal COES processing
- Coordinates all security aspects with external Security Services (user authentication, key exchanges, etc)
- Logs security activities

Security Services interface handling

- Manages the communications between any external Security Services

5.3.3.2.2.8 Platform Management

Details associated with the functionality of the COES Platform Management function are presented below.

Redundancy management

- Performs processing to ensure those COESs configured to serve as redundant peers stay in sync

Load balancing processing

- Assesses loading statuses using information from external CIES, as well as internal performance
- Processes rerouted requests due to load balancing processing

Inter-COES interface handling

- Handles all communications between COES serving as redundant or load balancing peers

Performance monitoring

- Performs self monitoring of health and operational performance
- Provides current health status for use with QOS management, load balancing processing and administrative monitoring / reporting

5.3.3.2.2.9 Mediation Management

Details associated with the functionality of the COES Mediation Management function are presented below.

Mediation handling

- Provides mediation support to translate incompatible requests and responses

Mediation Service interface handling

- Serves as communication conduit to external Mediation Service instances which perform required translations / mediation

5.3.3.2.2.10 General System Management

Details associated with the functionality of the COES General System Management function are presented below.

Administrative functionality handling

- Allows for the configuration of the various storage housekeeping functions
- Allows for configuration of security information
- Allows for the configuration and control of QOS functionality
- Reports on changes to subscription services to which the COES may be a participant in

Logging

- Consolidates logging from all COES processes for administrative access

Alarm reporting

- Consolidates alarms for reporting for administrative access

Archival handling

- Receives information for archival storage
- Performs data store housekeeping / purging
- Serves as location for archival storage
- Allows for administrative access to archival storage

Reporting

- Consolidates reporting info for administrative access

Backup/restore handling

- Manages functions associated with backing up and restoring COES

Change management

- Provides functionality to allow for the addition of new services, interface types and data.

Management / Admin Services interface

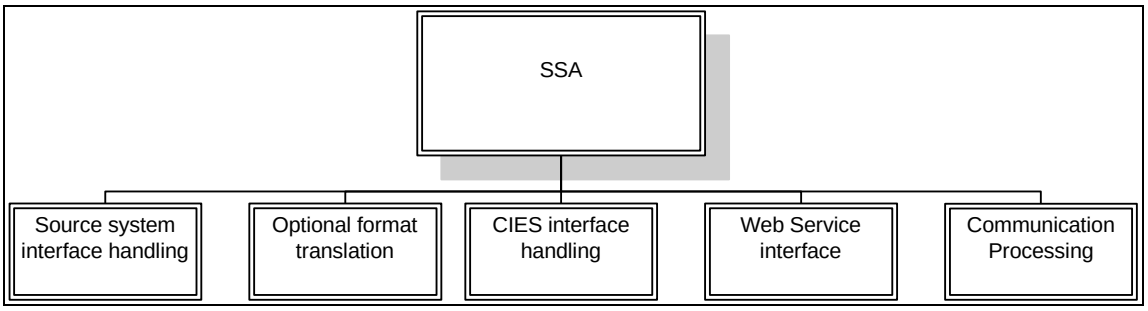
- Provide interface for human access to administrative functionality
- Provides secure access to administrative functions

Remote access support

- Provides interface for remote access to administrative functionality

5.3.3.2.3 SSA

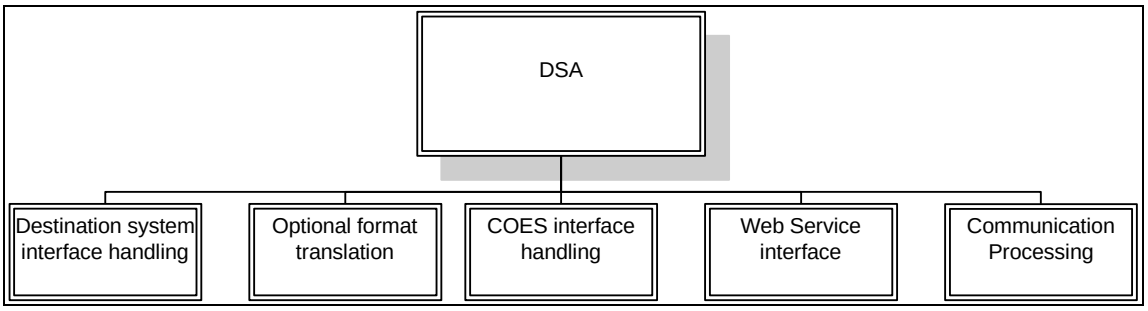
The figure below presents these key functional components associated with the SSA design. A subsequent section addresses the flow of information between the SSA and various external entities.



Additional details concerning the design of the SSA are TBD until more defined requirements become available.

5.3.3.2.4 DSA

The figure below presents these key functional components associated with the DSA design. A subsequent section addresses the flow of information between the DSA and various external entities.

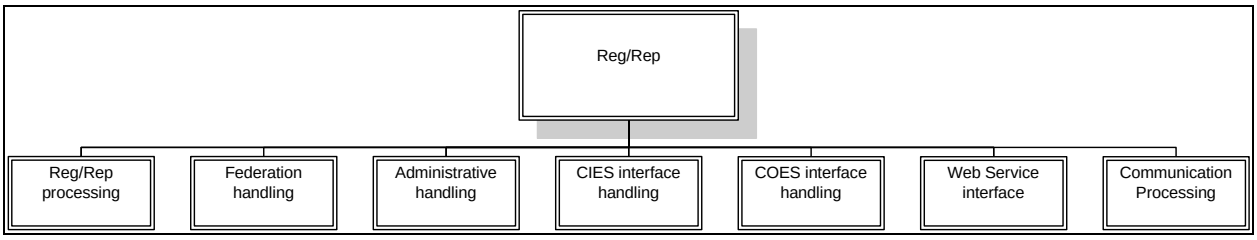


Additional details concerning the design of the DSA are TBD until more defined requirements become available.

5.3.3.2.5 Registry/Repository (Reg/Rep)

A federated network of Reg/Rep instances will be provided for the purpose of metadata, service and data discovery, as well as for the tagging of which data is included into the SAS.

The figure below presents these key functional components associated with the Reg/Rep design. A subsequent section addresses the flow of information between the Reg/Rep and various external entities.

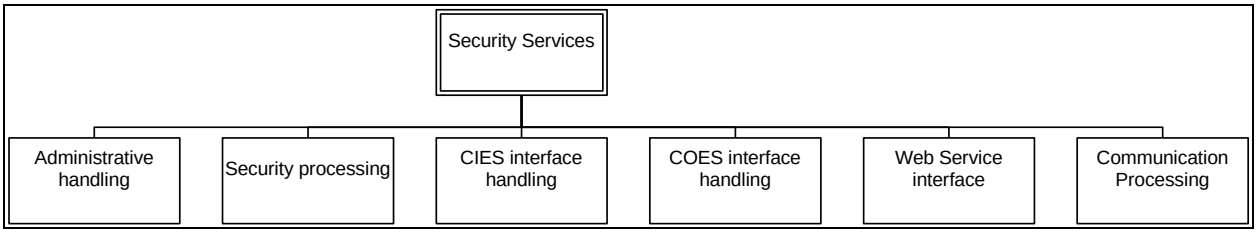


Additional details concerning the design of the Reg/ Rep are TBD until more defined requirements become available.

5.3.3.2.6 Security Services

Web service-based Security Services will provide for the exchange / storage of security and trust related shared information (tokens, keys, etc) as well as security processing to include encryption, decryption, authentication, and boundary security. Security is intended to be provided on several levels, including: transport layer communications, application, message and data.

The figure below presents these key functional components associated with the Security Services design. A subsequent section addresses the flow of information between Security Services and various external entities.

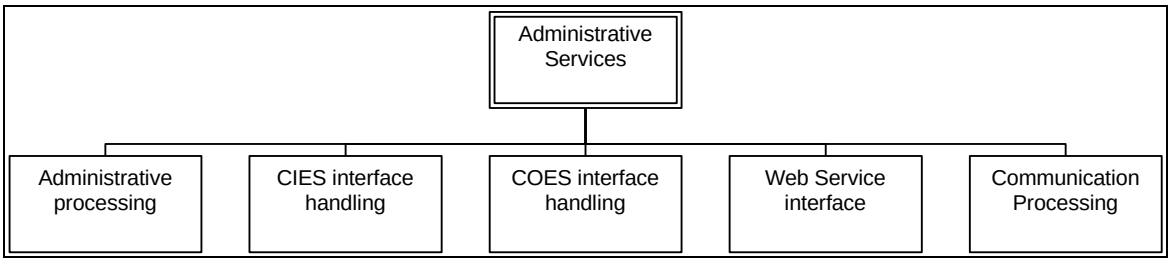


Additional details concerning the design of Security Services are TBD until more defined requirements become available.

5.3.3.2.7 Administrative Services

Distributed (or possibly centralized) administrative functions will be necessary to control, operate, and monitor all the systems that comprise the Cube. These functions are intended to be provided via a series of web service-based Administrative Services.

The figure below presents these key functional components associated with the Administrative Services design. A subsequent section addresses the flow of information between Administrative Services and various external entities.

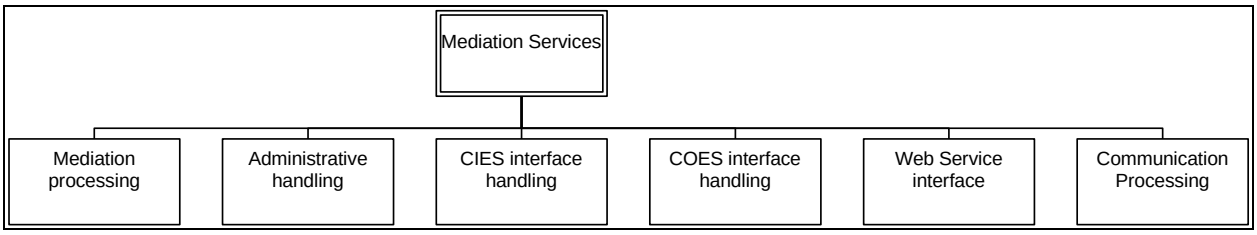


Additional details concerning the design of Administrative Services are TBD until more defined requirements become available.

5.3.3.2.8 Mediation Service

In order to allow for the interoperability between otherwise incompatible source (producer) and destination (consumer) systems, standalone Mediation Services may be required to translate between incompatible data formats and / or incompatible data exchange protocols.

The figure below presents these key functional components associated with the Mediation Services design. A subsequent section addresses the flow of information between Mediation Services and various external entities.



Additional details concerning the design of Mediation Services are TBD until more defined requirements become available.

5.3.4 SV-4b – System / Services Data Flows

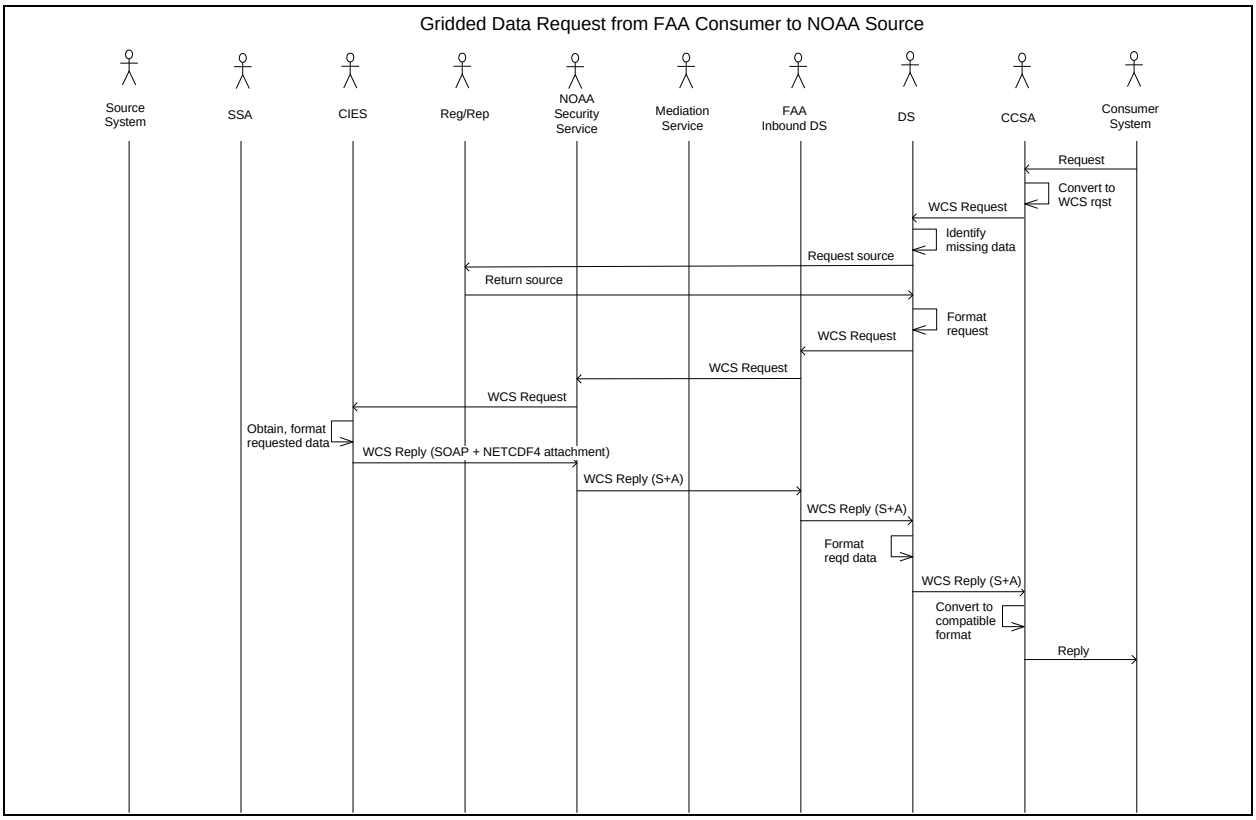
5.3.4.1 Cube Level

Numerous uses cases have been envisioned to support the access to and exchange of data using the 4D Cube. Participating systems in these data exchanges include both FAA as well as NOAA architecture components. For reference, FAA components are described in the WIDB IT System Architecture Document.

The various figures below present key data flows / information exchanges associated with the Cube. They include cases where NOAA is the data provider, where NOAA is the data recipient, where FAA is the data provider, and where FAA is the data recipient. These flows include both request/reply and subscription based data exchanges, as well as several ingest and subscription configuration data flows.

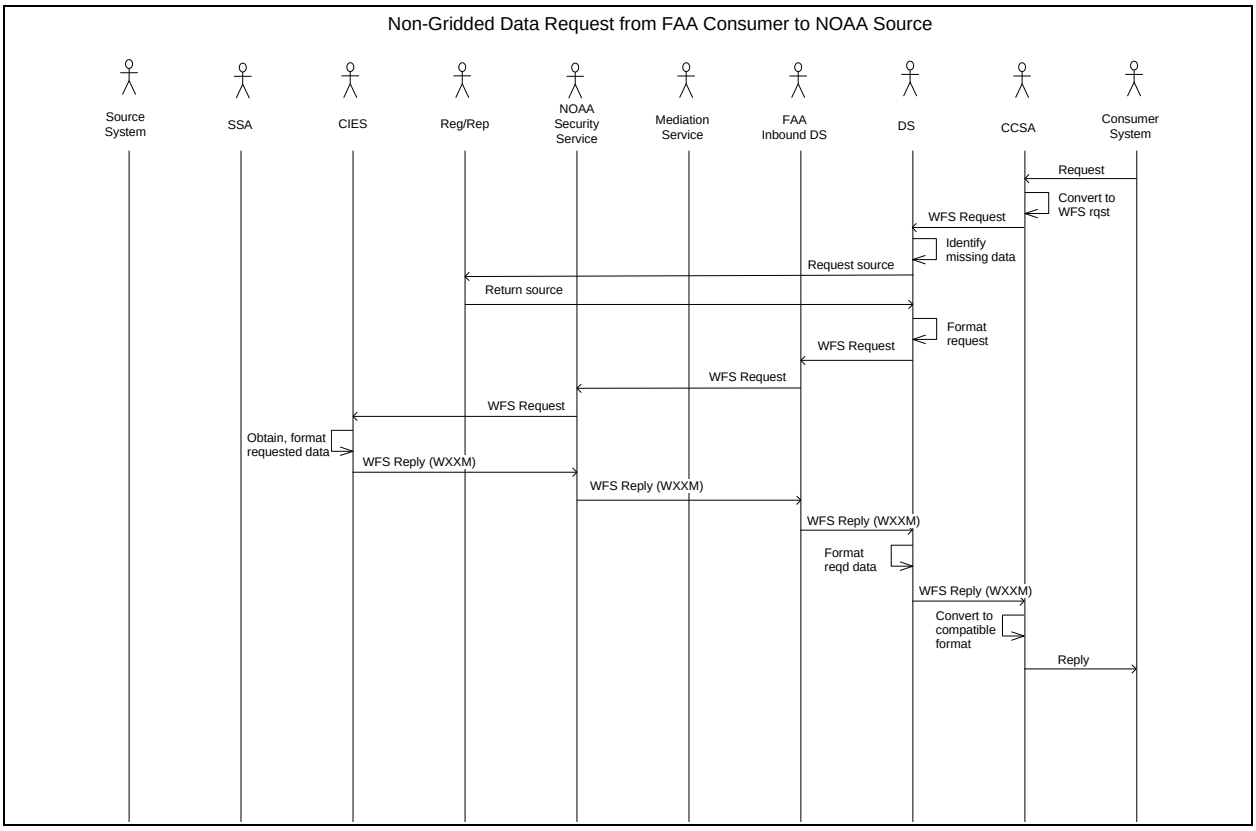
5.3.4.1.1 Gridded Data Request from FAA Consumer to NOAA Source

This data exchange depicts an FAA Consumer System requesting gridded NetCDF4 formatted data from a NOAA CIES.



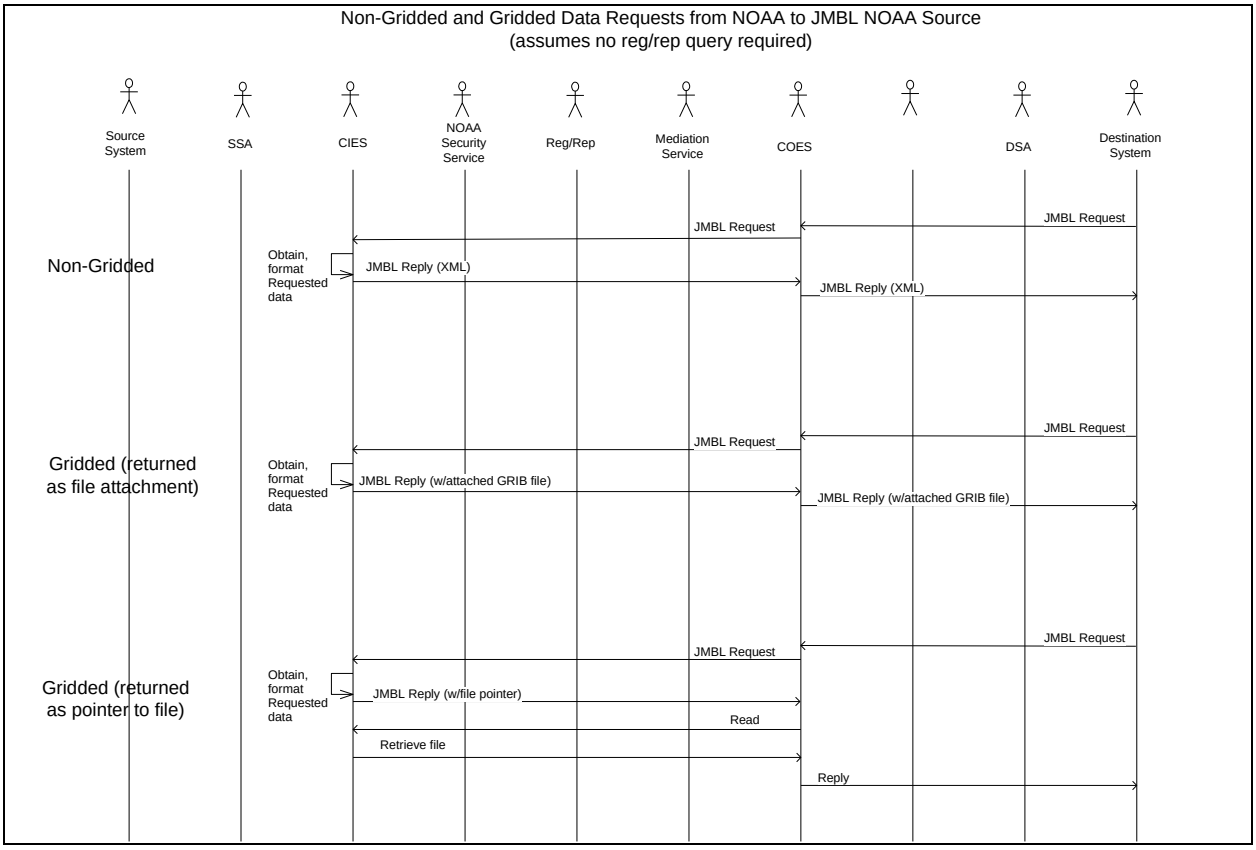
5.3.4.1.2 Non-Gridded Data Request from FAA Consumer to NOAA Source

This data exchange depicts an FAA Consumer System requesting non-gridded formatted data from a NOAA CIES.



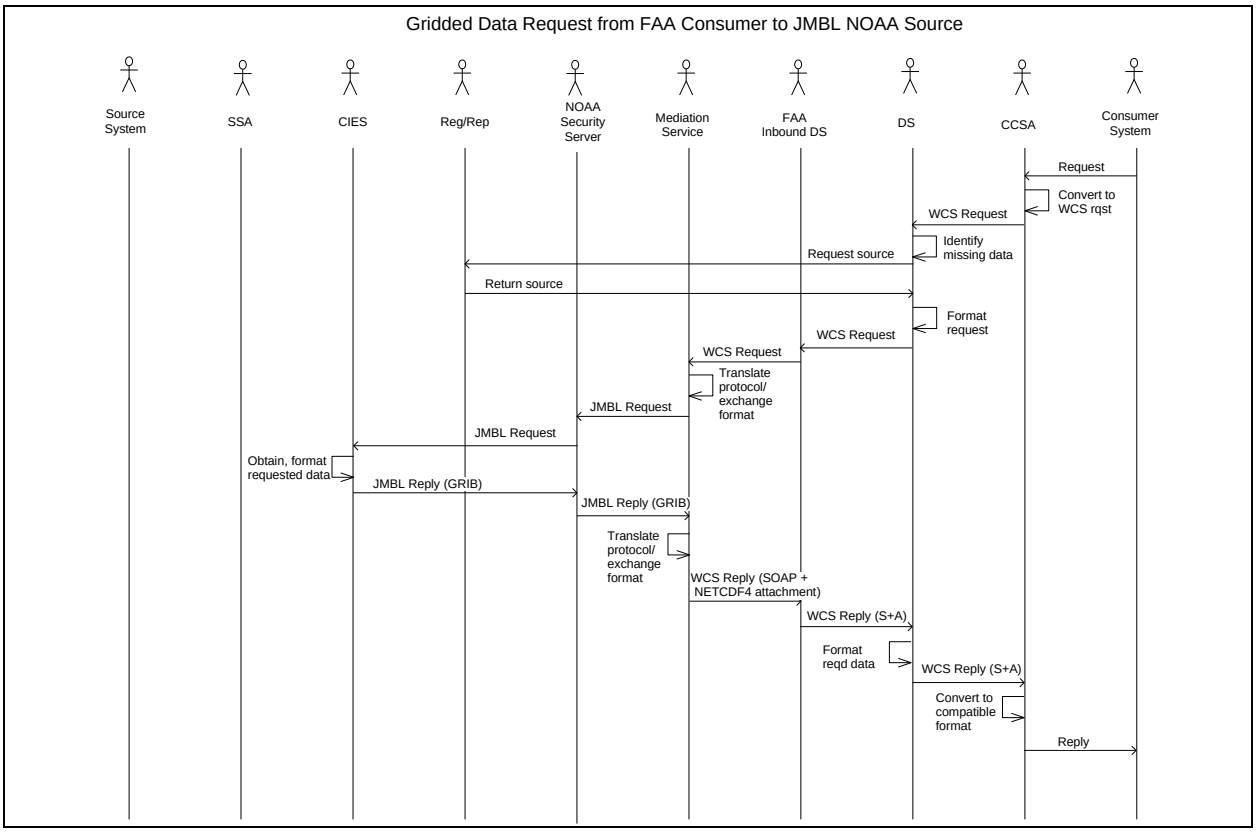
5.3.4.1.3 NOAA JMBL Requests

This data exchange depicts a NOAA Destination System requesting JMBL non-gridded data, requesting JBML gridded data that is returned with the reply as a file attachment, and requesting JMBL gridded data with a pointer to the resultant gridded data file being returned.



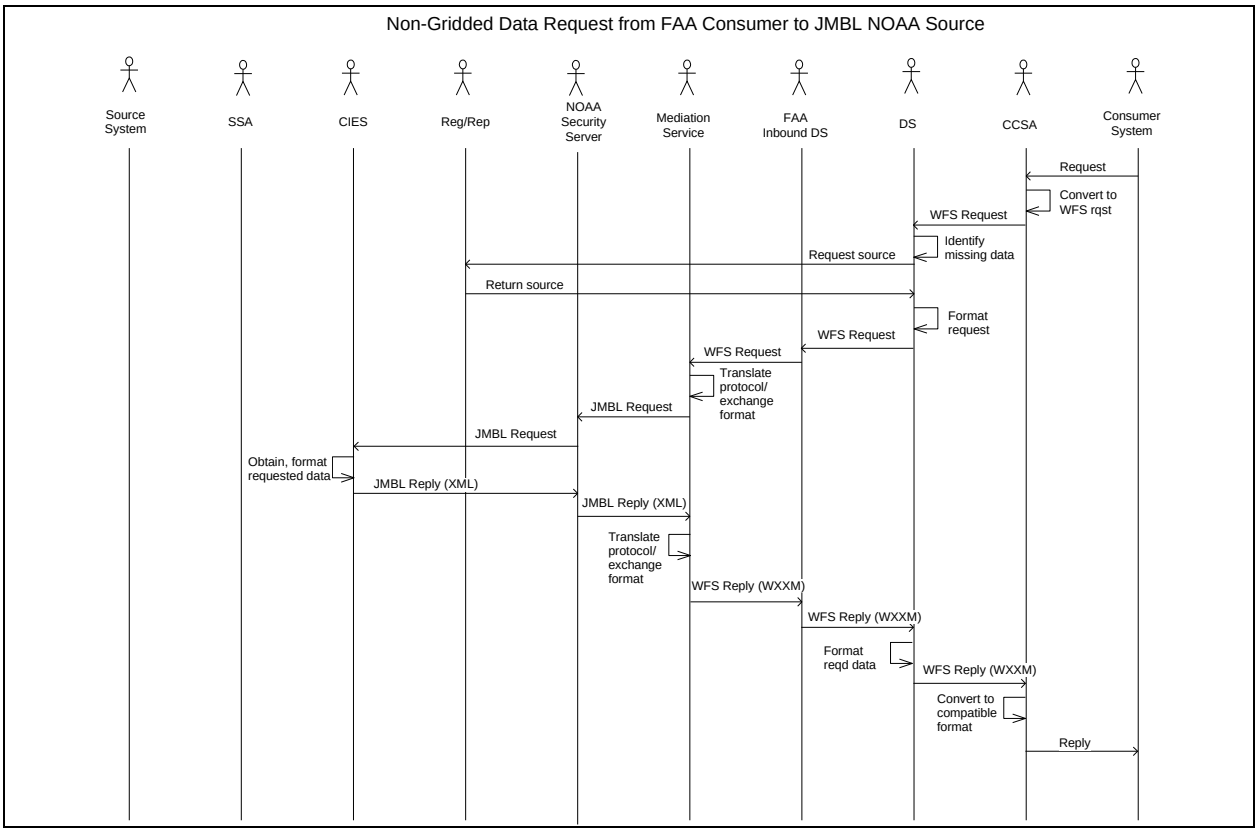
5.3.4.1.4 Gridded Data Request from FAA Consumer to JMBL NOAA Source

This data exchange depicts an FAA Consumer System requesting gridded data from a NOAA JMBL-Server based CIES where mediation is required.



5.3.4.1.5 Non-Gridded Data Request from FAA Consumer to JMBL NOAA Source

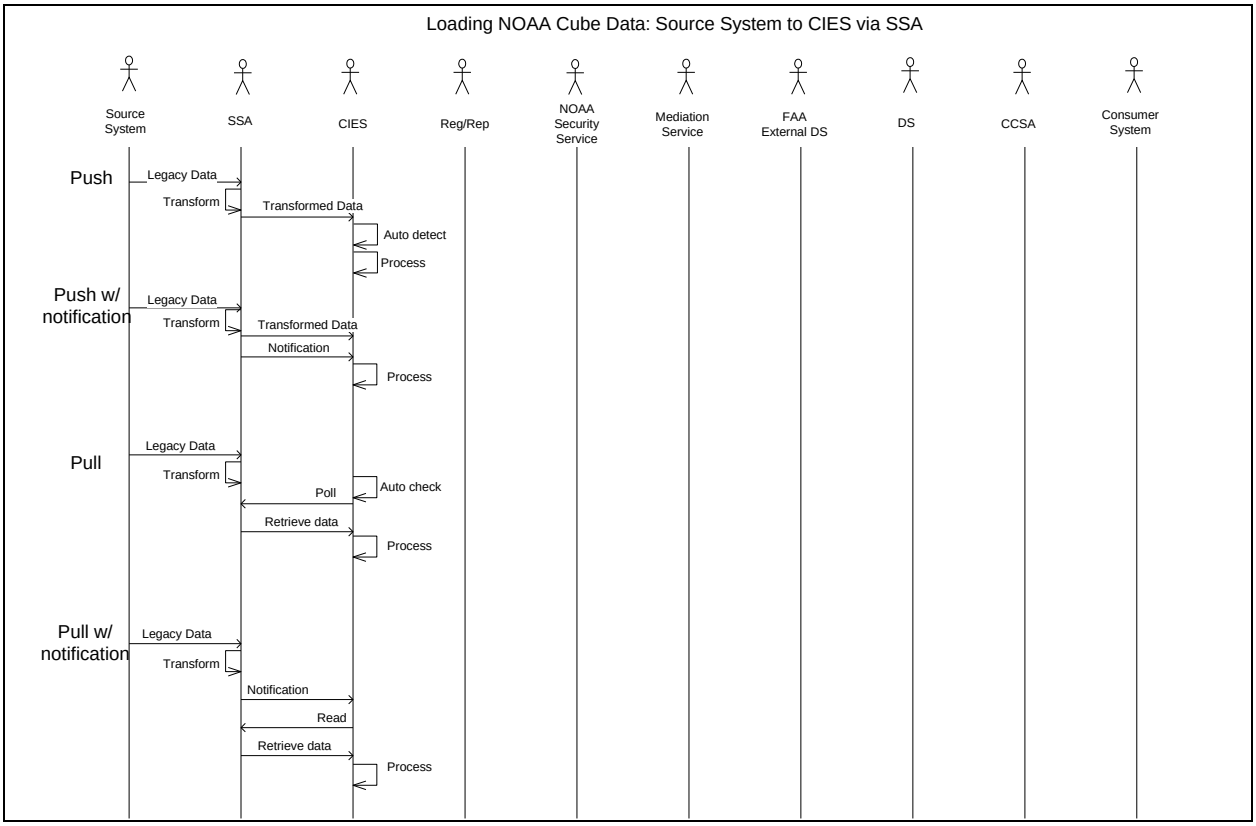
This data exchange depicts an FAA Consumer System requesting non-gridded data from a NOAA JMBL-Server based CIES where mediation is required.



5.3.4.1.6 NOAA CIES Ingest Options via SSA

This data exchange depicts several optional approaches for a Source System to provide data for CIES ingest using a SSA. These include:

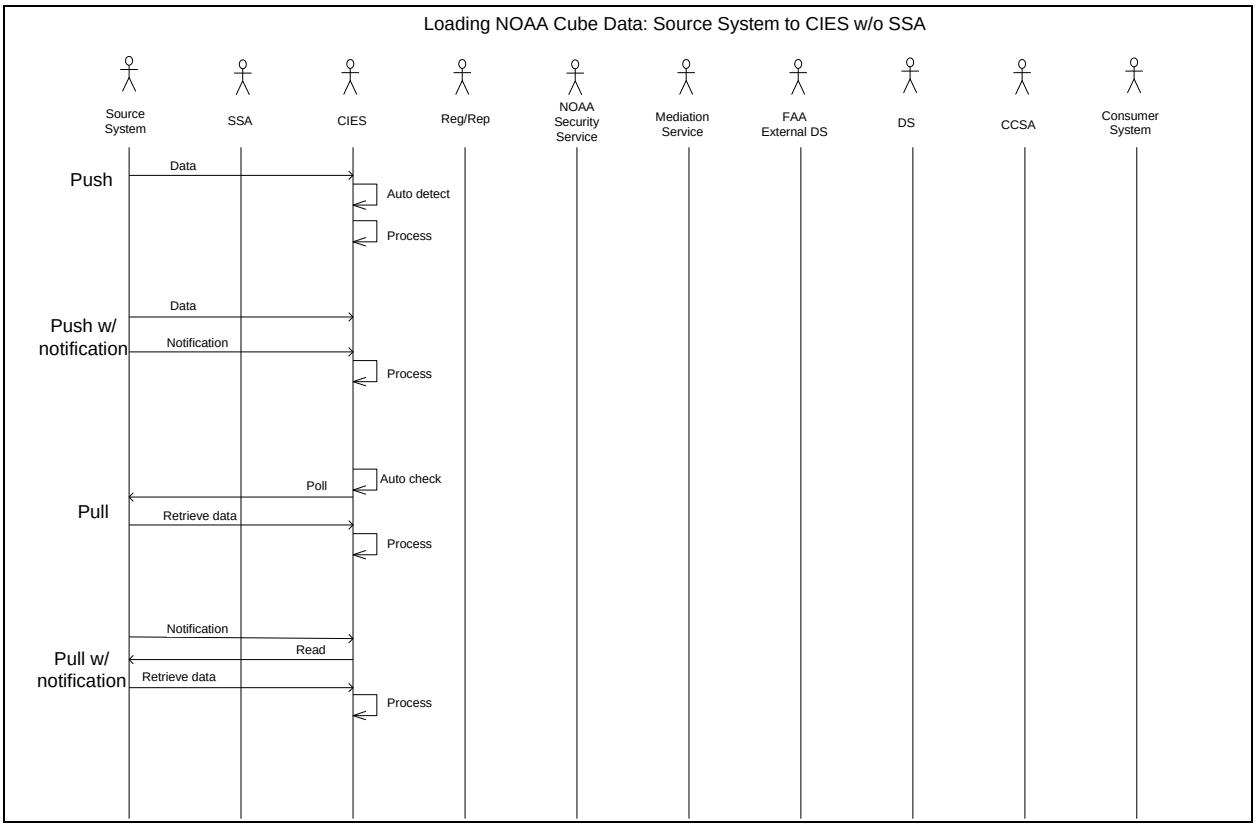
- Push model
- Push model with notification
- Pull model
- Pull model with notification



5.3.4.1.7 NOAA CIES Ingest Options without SSA

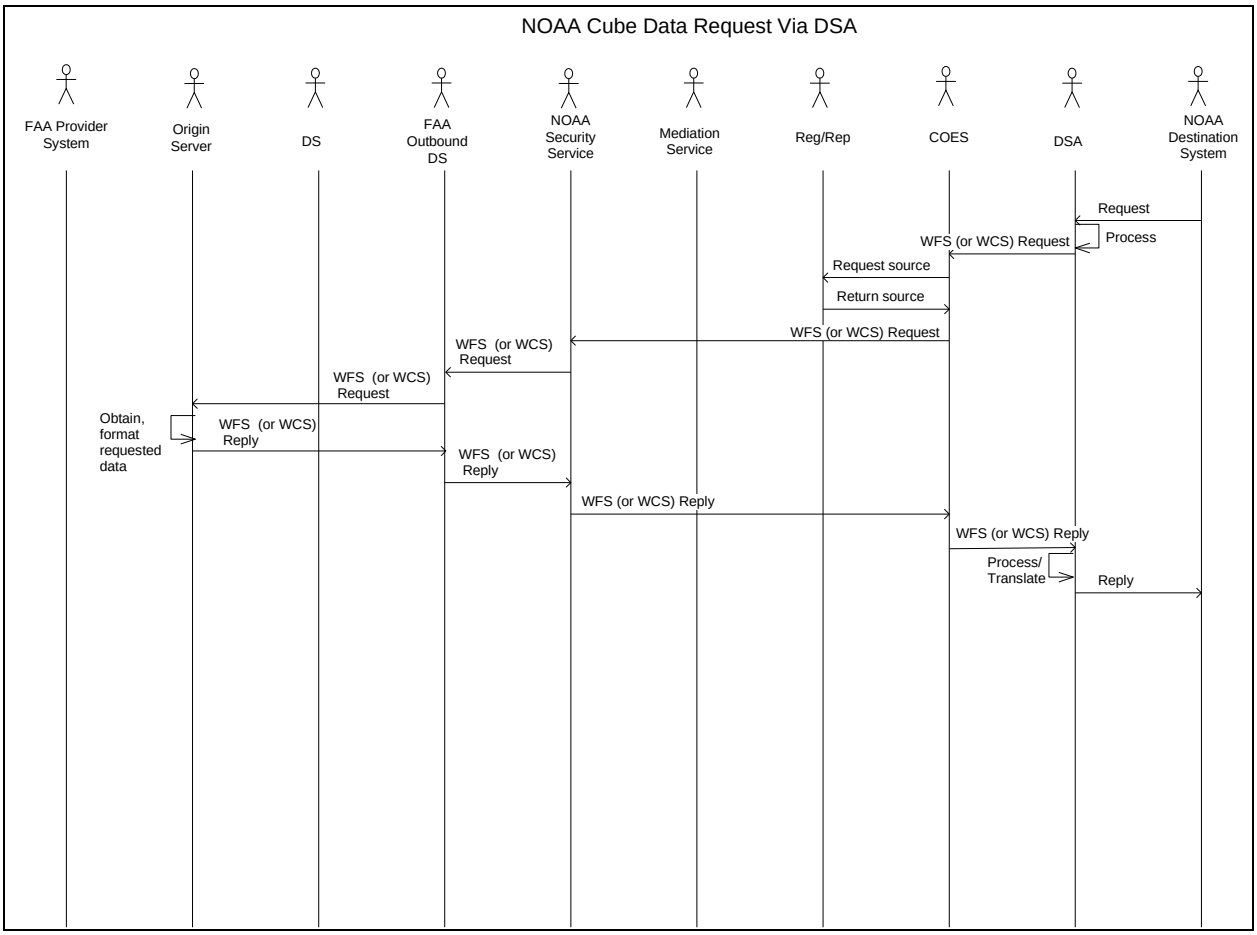
This data exchange depicts several optional approaches for a Source System to provide data for CIES ingest directly to the CIES (where the SSA is either built into the Source System or unnecessary). These include:

- Push model
- Push model with notification
- Pull model
- Pull model with notification



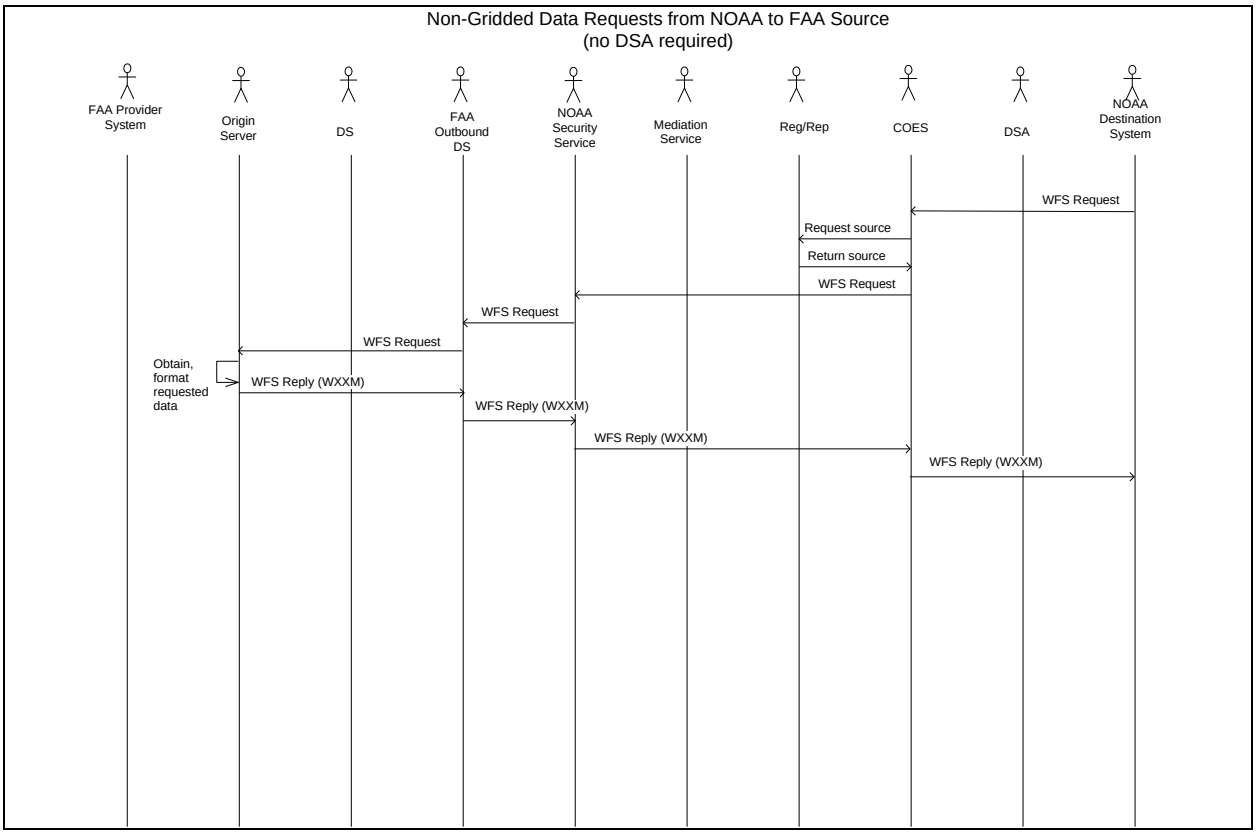
5.3.4.1.8 Data Request from NOAA Destination System to FAA Provider System

This data exchange depicts a NOAA Destination System requesting data, via a DSA, from an FAA Provider System.



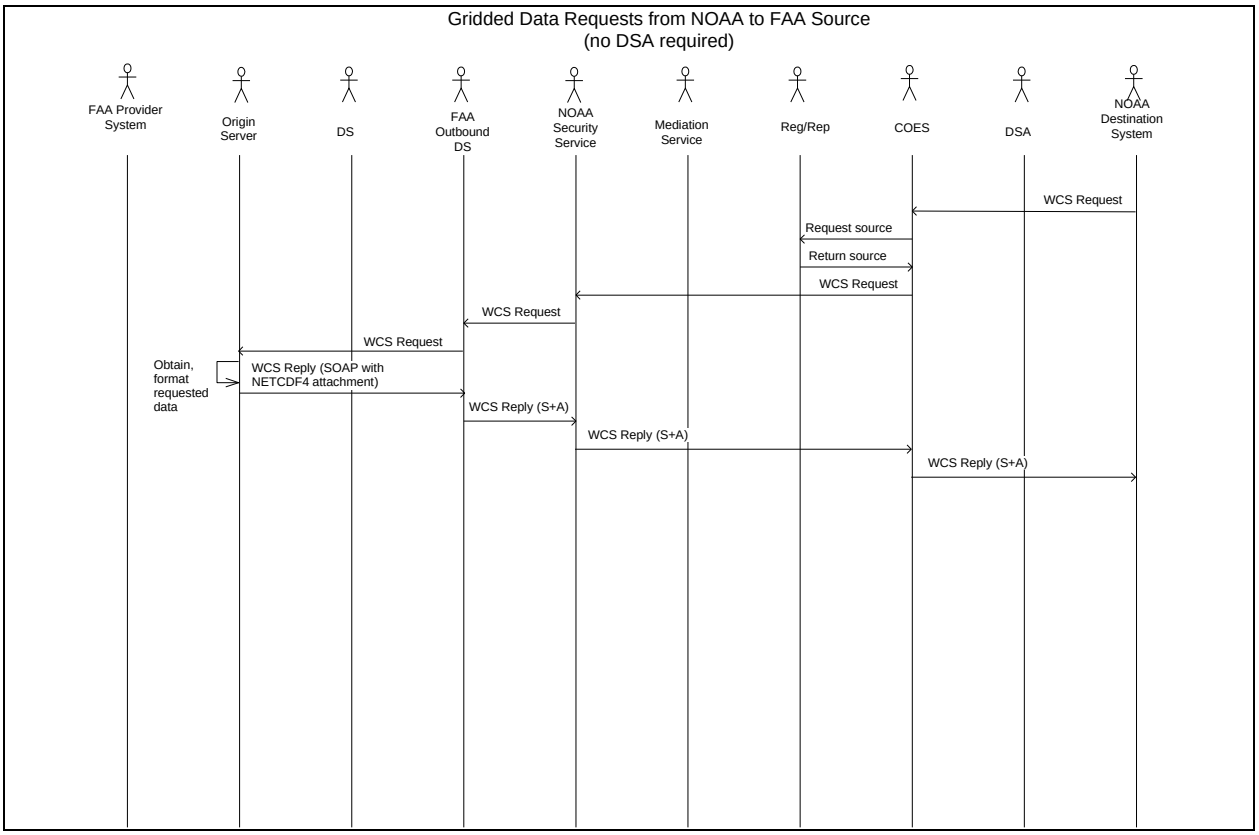
5.3.4.1.9 Non-Gridded Data Request from NOAA Destination System to FAA Provider System

This data exchange depicts a NOAA Destination System requesting non-gridded data, without a DSA (assumed to be included in the Destination System or unnecessary), from an FAA Provider System.



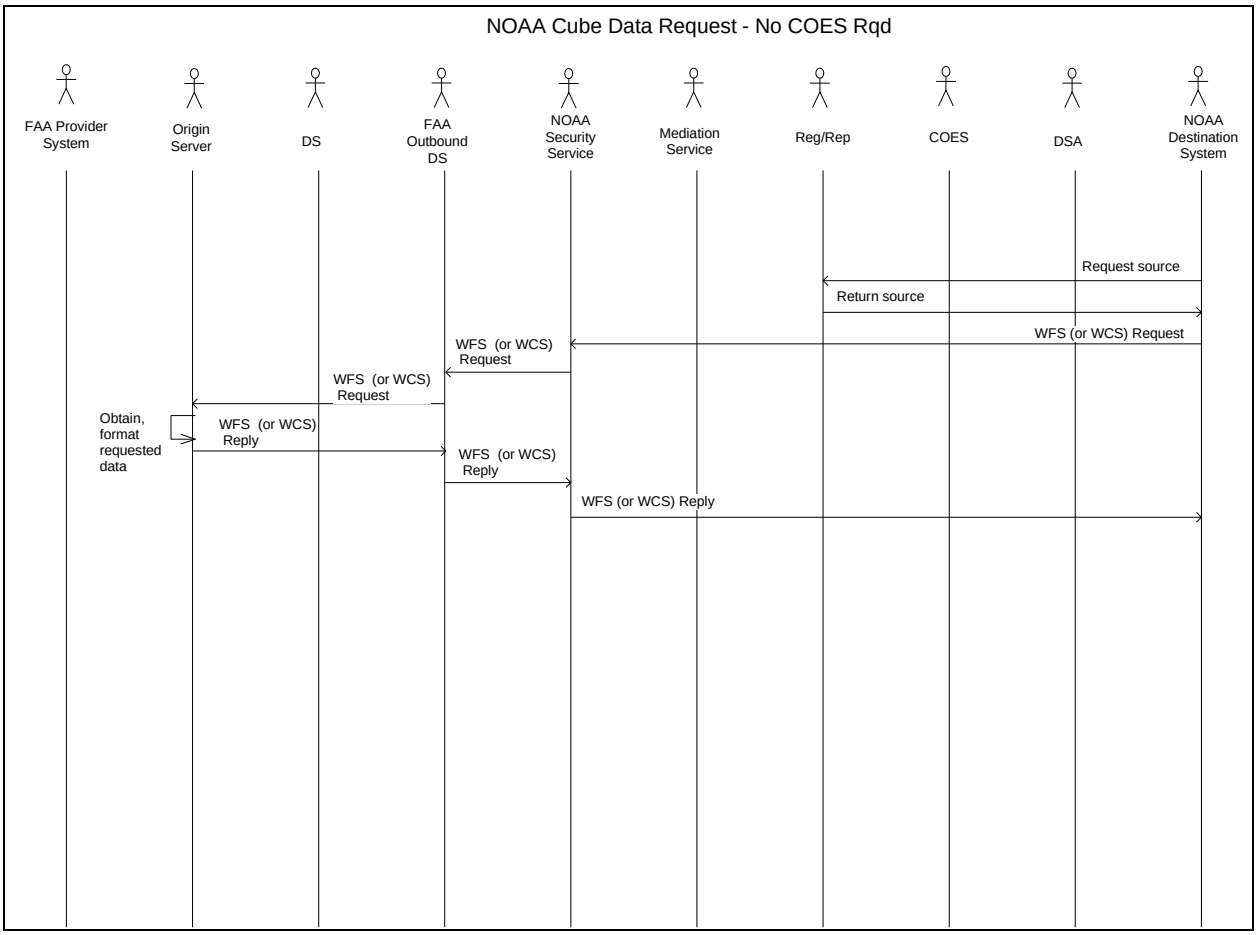
5.3.4.1.10 Gridded Data Request from NOAA Destination System to FAA Provider System

This data exchange depicts a NOAA Destination System requesting gridded data, without a DSA (assumed to be included in the Destination System or unnecessary), from an FAA Provider System.



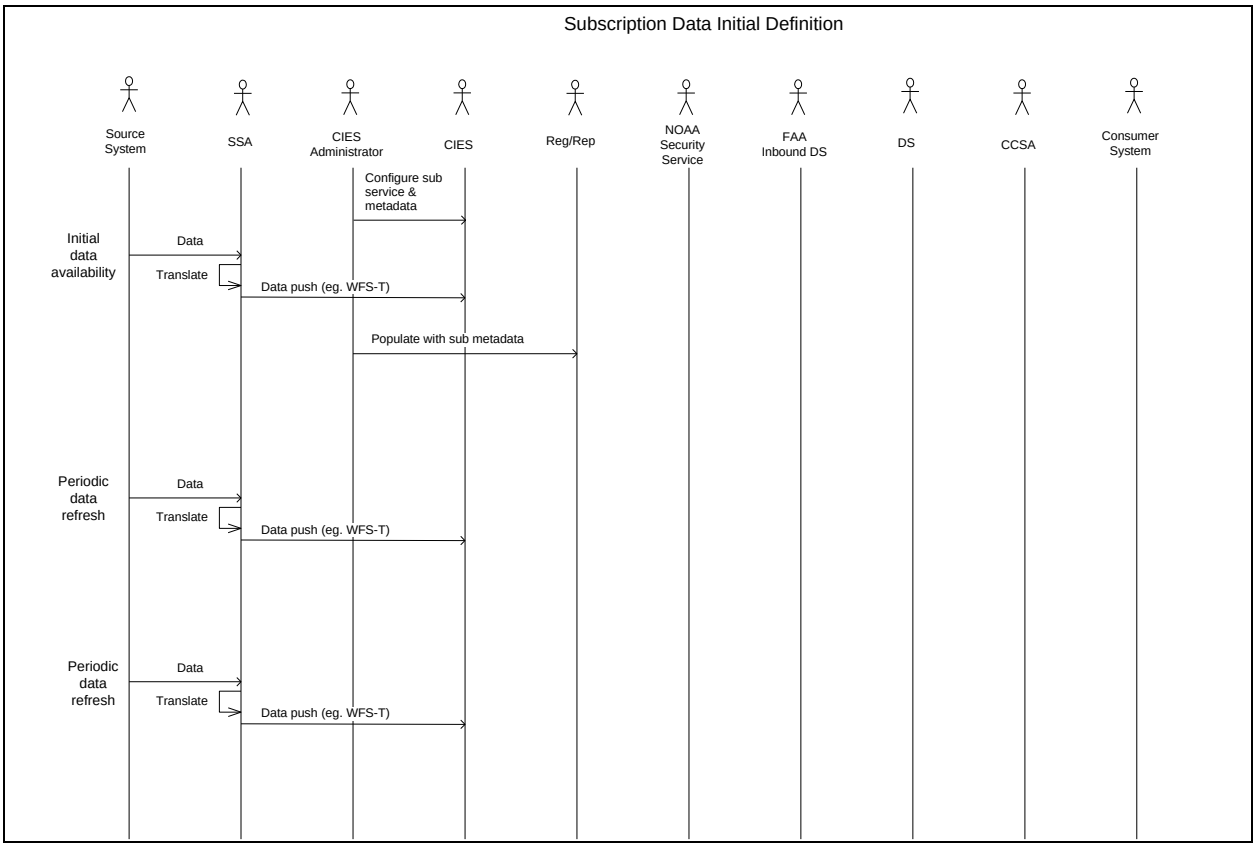
5.3.4.1.11 NOAA Cube Data Request without COES

This data exchange depicts a request for data from an FAA Provided System where the DSA and COES are embedded in the Destination System.



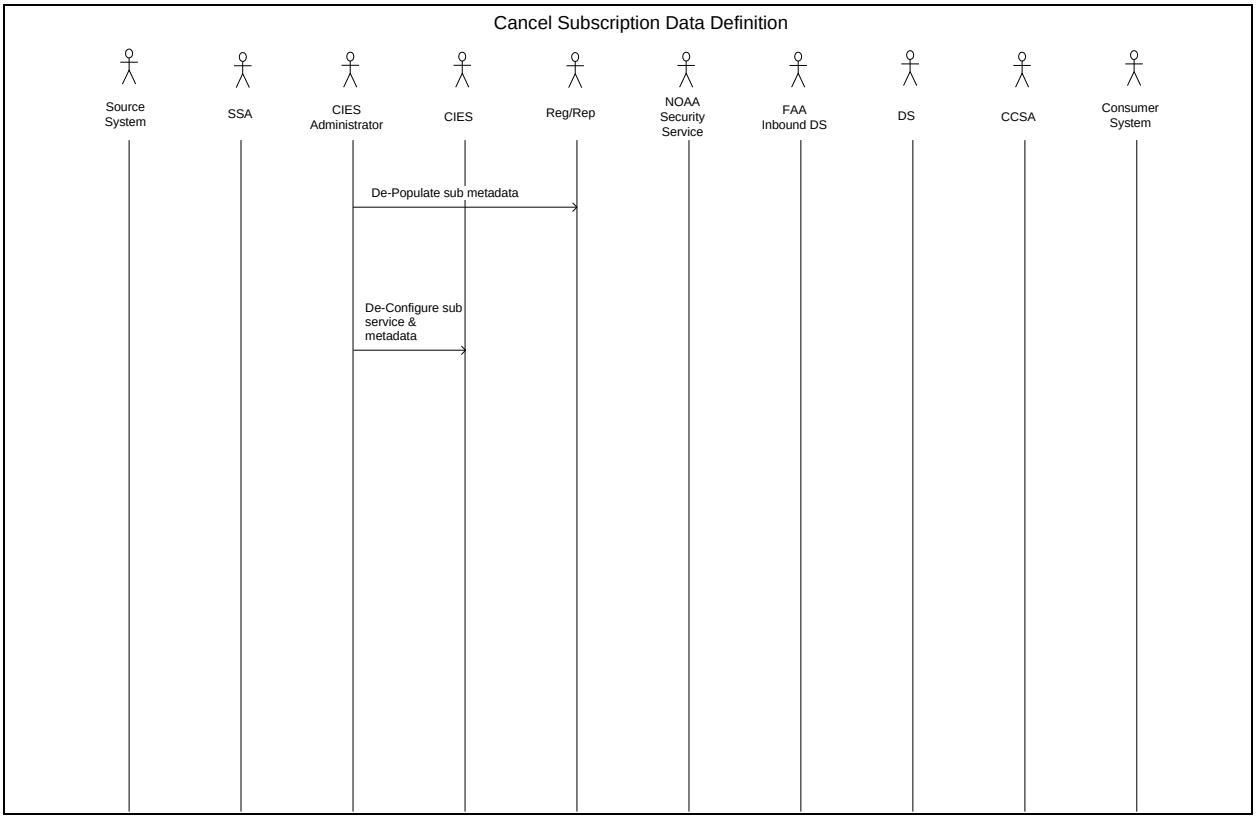
5.3.4.1.12 Subscription Data Initial Definition

This data exchange depicts the establishment of a subscription service and subsequent periodic data refreshes.



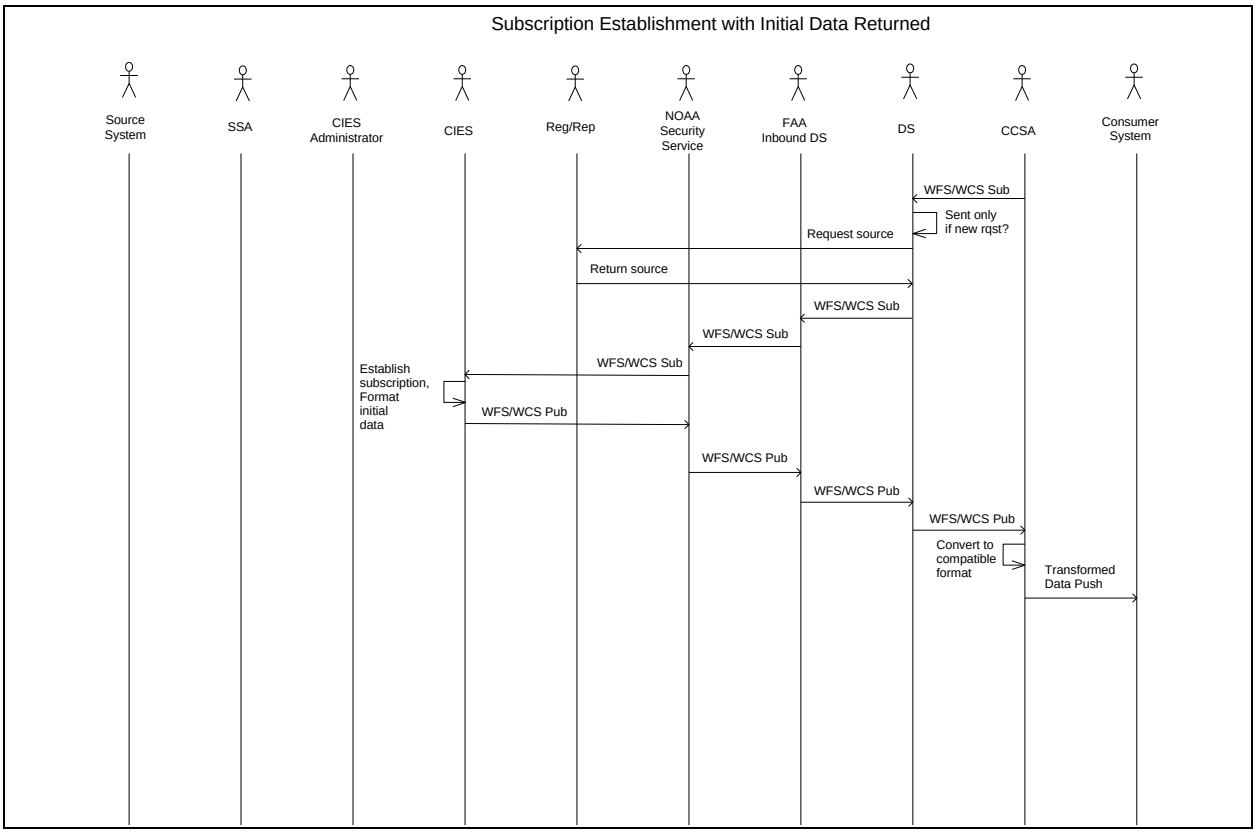
5.3.4.1.13 Subscription Cancellation

This data exchange depicts the cancellation of an existing subscription service.



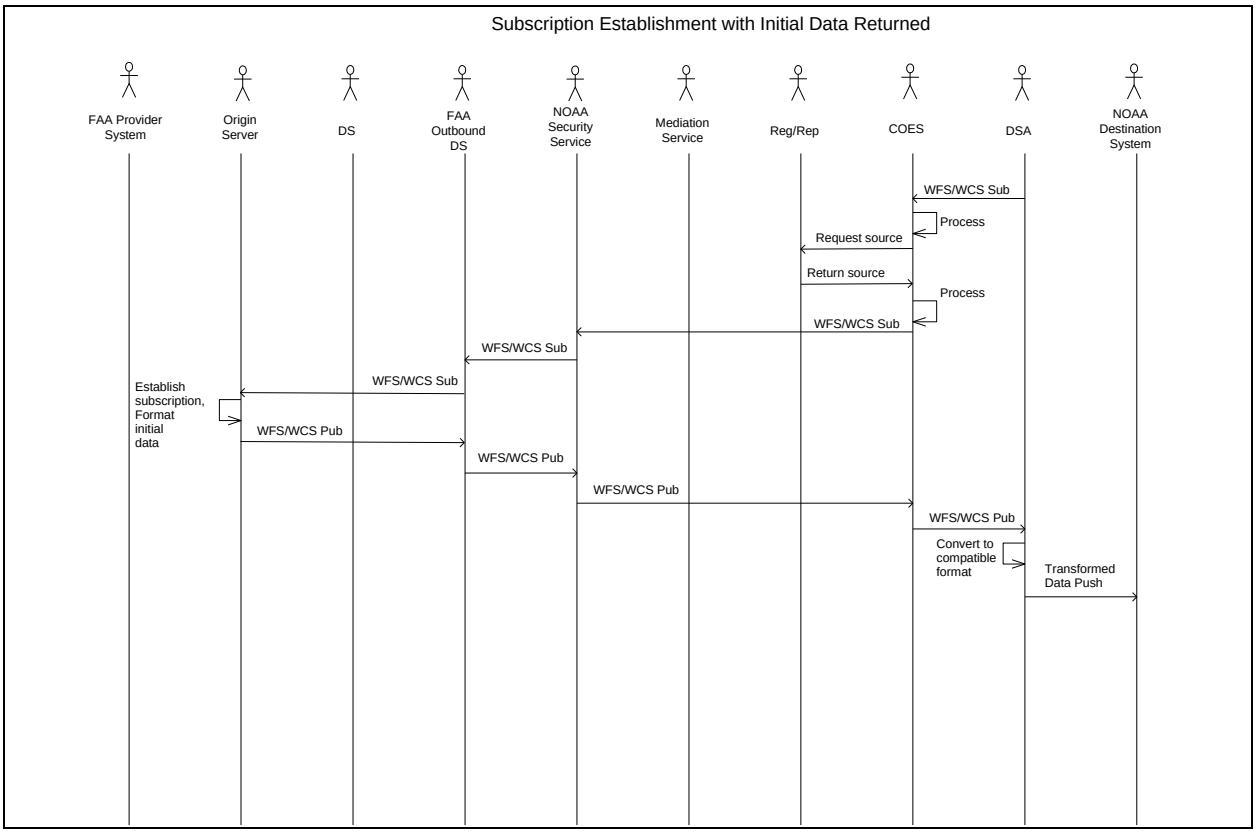
5.3.4.1.14 FAA Subscription Establishment

This data exchange depicts the registering of an FAA Consumer System for a NOAA provided subscription service.



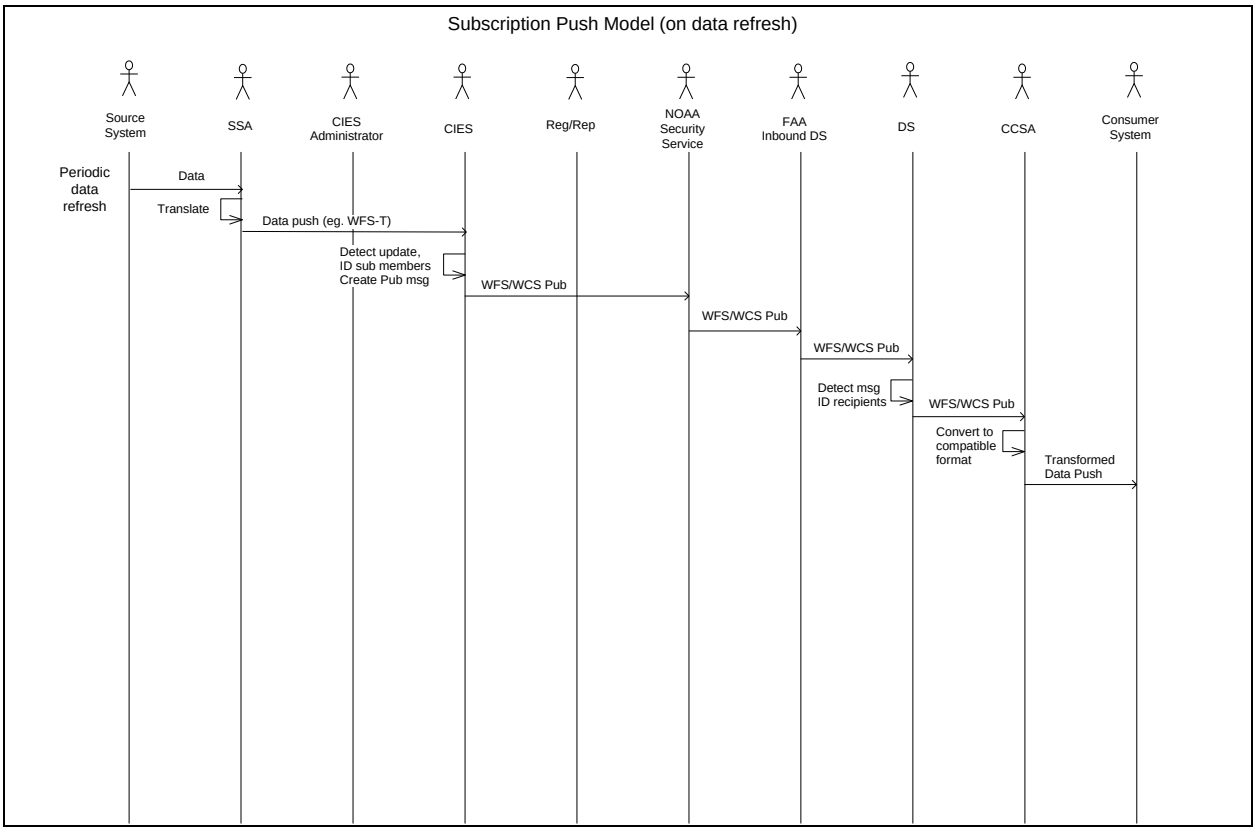
5.3.4.1.15 NOAA Subscription Establishment

This data exchange depicts the registering of a NOAA Destination System for an FAA provided subscription service.



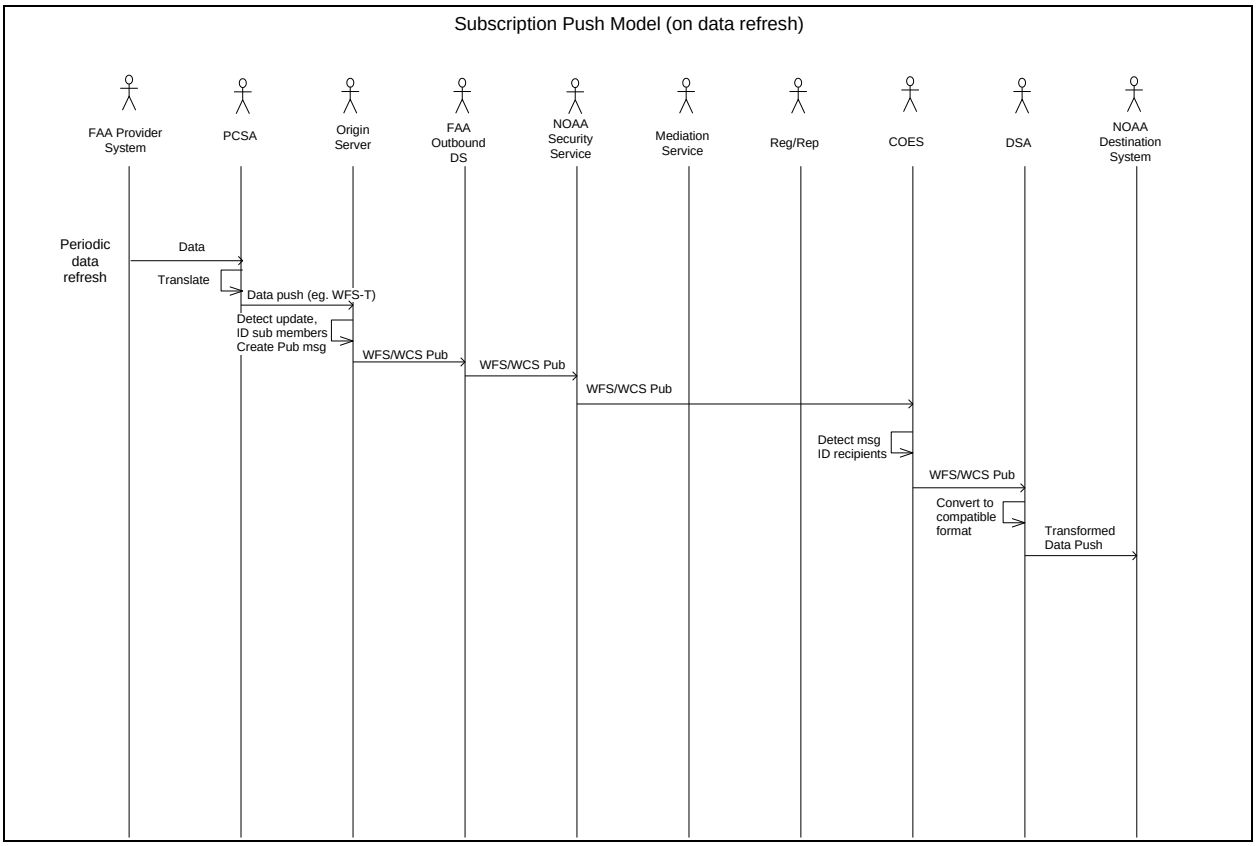
5.3.4.1.16 NOAA Subscription Push Model

This data exchange depicts the delivery of NOAA subscription data to an FAA Consumer System via a push model.



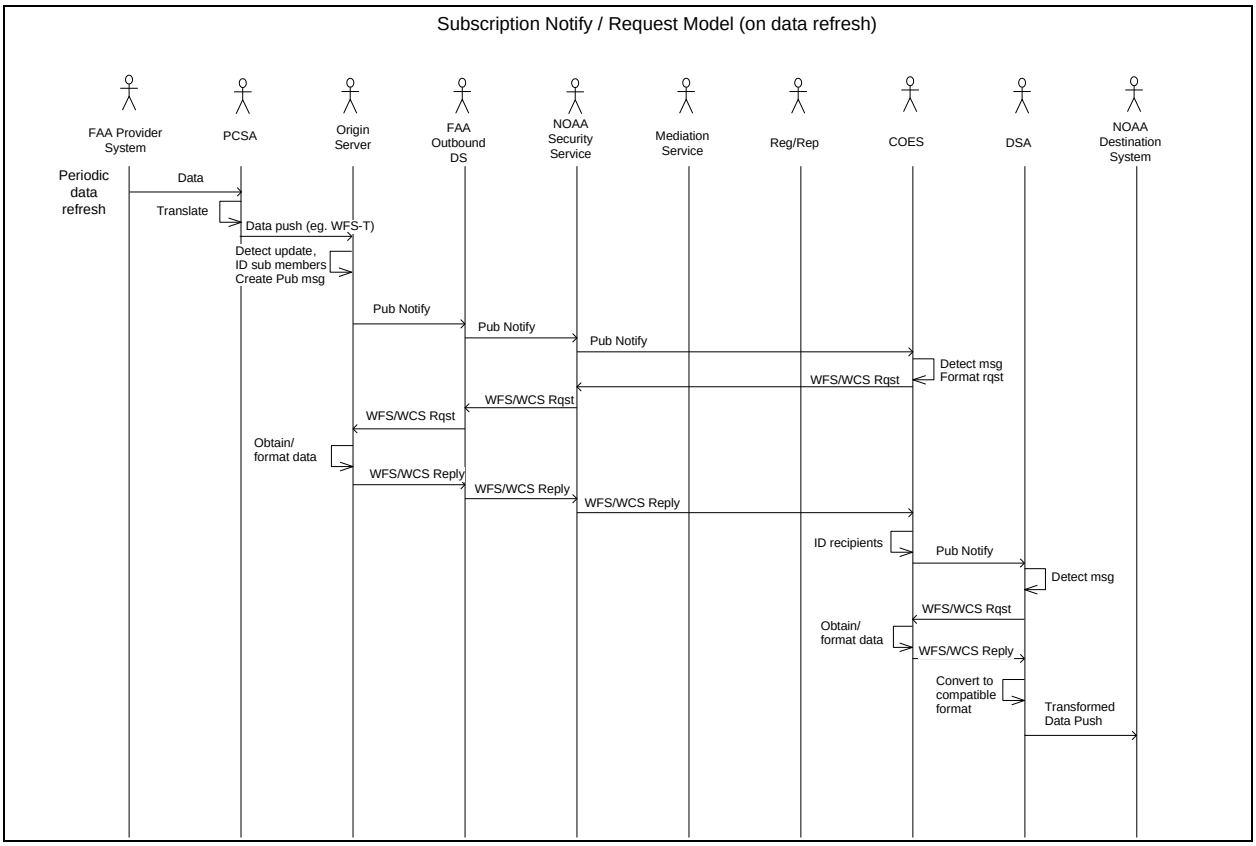
5.3.4.1.17 FAA Subscription Push Model

This data exchange depicts the delivery of FAA subscription data to a NOAA Destination System via a push model.



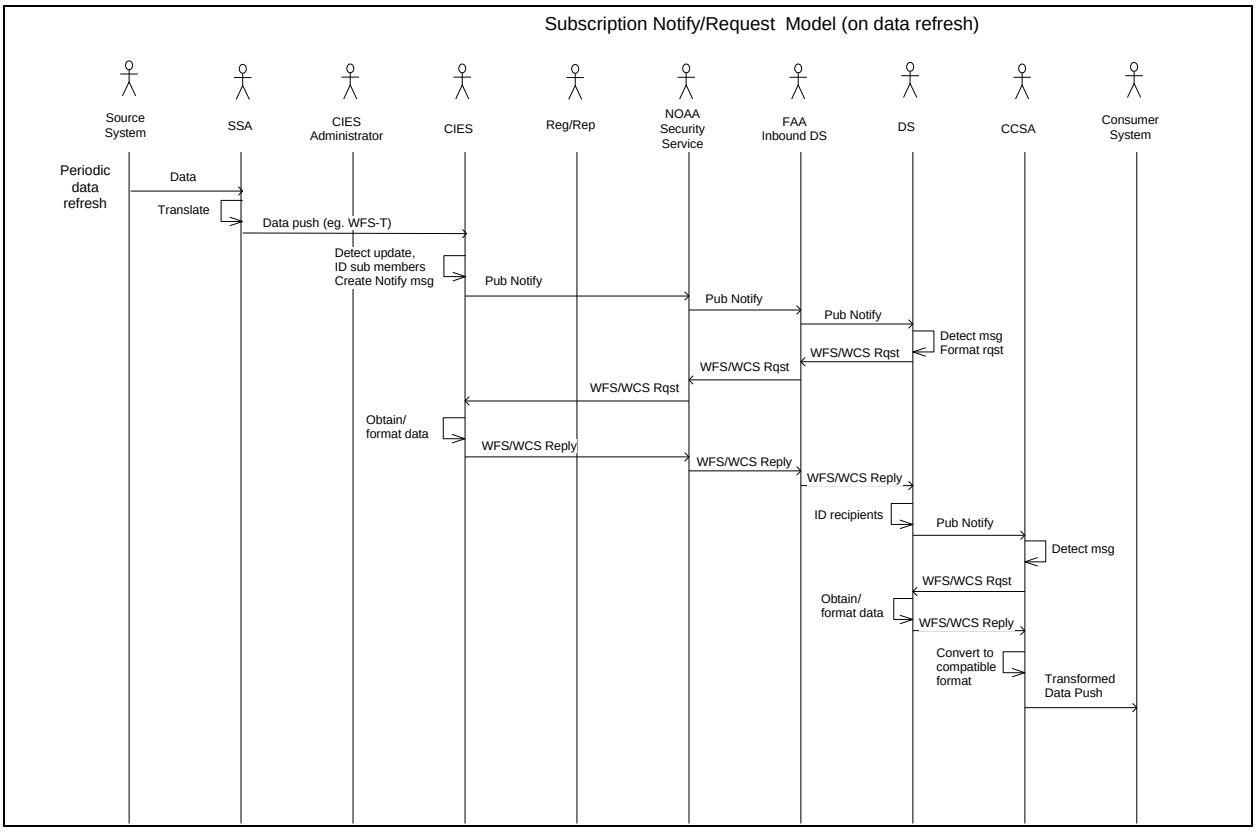
5.3.4.1.18 FAA Subscription Notify / Request Model

This data exchange depicts the delivery of FAA subscription data to a NOAA Destination System via a notification / request model.



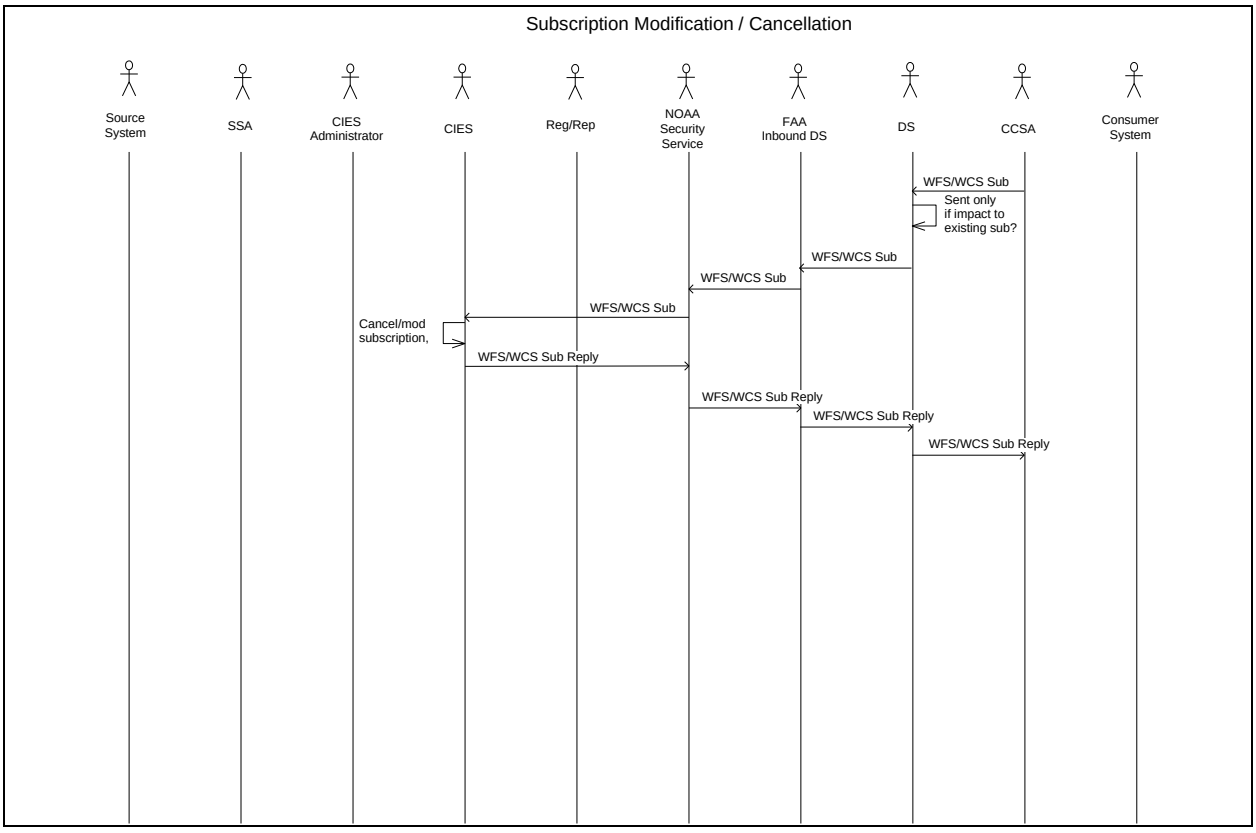
5.3.4.1.19 NOAA Subscription Notify / Request Model

This data exchange depicts the delivery of NOAA subscription data to an FAA Consumer System via a notification / request model.



5.3.4.1.20 Subscription Modification / Cancellation

This data exchange depicts an FAA Consumer System modifying / cancelling an existing subscription with a NOAA subscription service.



5.3.4.1.21 Additional Data Exchanges

Numerous additional data exchange examples exist and will be developed in future versions of this document. These will include:

- Inter-Cube Security Exchanges
- Additional Mediation Service Exchanges
- Administrative Services exchanges
- Reg / Rep exchanges
- And others

5.3.4.2 System Level

5.3.4.2.1 CIES level

The matrix below presents the exchange of information between the functions supported by each CIES and between a CIES and external entities.

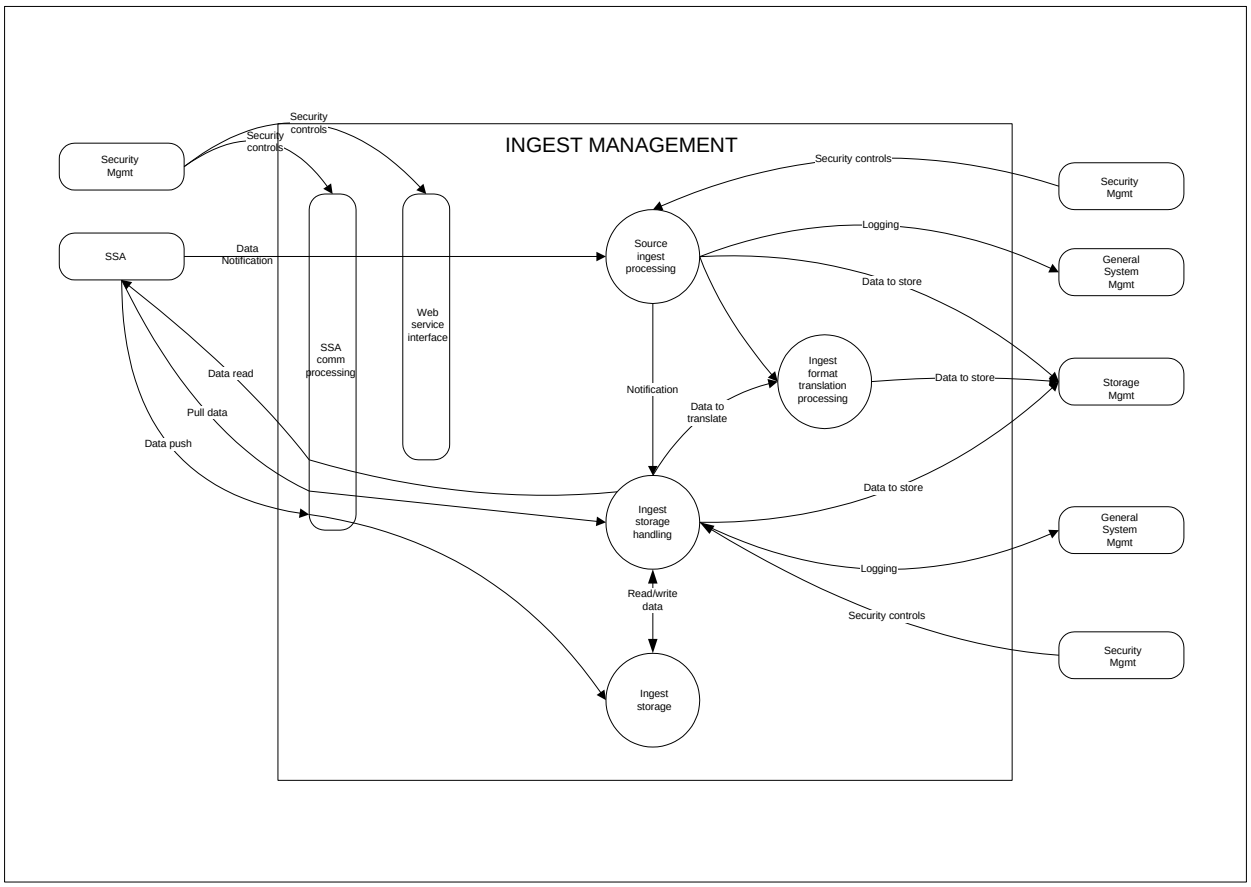
		Internal to CIES										External to CIES							
		Ingest management	Storage management	Cube request/reply management	Subscription management	Cube retrieval management	Platform management	Discoverability management	Security management	Mediation management	QOS management	General system management	SSA	CIES	Cube	Security Services	Reg/Rep	Mediation Service	Admin Services
Internal to CIES	Ingest management		Data to store						Security controls			Logging	Data Notification Data read Pull data Data push						
	Storage management	Data to store		Requests Filtered requests Reply data Error reply	Data store coordination							Data for archive Configuration control Pre-processing configuration							
	Cube request/reply management		Requests Filtered requests Reply data Error reply		Subscription delivery initiation / notification Subscription requests (add, mod, cancel)	Data for temporary storage	Current loading guidance Rerouted requests		Security controls	Mediation support	QOS controls	Logging			Requests Subscription requests (add/mod/cancel) Reply Notification Error				
	Subscription management		Data store coordination	Subscription delivery initiation / notification Subscription requests (add, mod, cancel)					Security controls		QOS controls	Logging Subscription definitions			Subscription service availability / cancellation notification				
	Cube retrieval management			Data for temporary storage					Security controls	Mediation support	QOS controls	Logging Storage housekeeping configuration			Requests Retrieve				
	Platform management			Current loading guidance Rerouted requests				Service availability info			Performance statistics	Performance details		Inter-CIES messaging Rerouted requests					
	Discoverability management						Service availability info		Security controls						Metadata Request Reply		Metadata		

		Internal to CIES										External to CIES							
		Ingest management	Storage management	Cube request/reply management	Subscription management	Cube retrieval management	Platform management	Discoverability management	Security management	Mediation management	QOS management	General system management	SSA	CIES	Cube	Security Services	Reg/Rep	Mediation Service	Admin Services
	Security management	Security controls		Security controls	Security controls	Security controls		Security controls				Security controls Security configuration Logging				Security controls			
	Mediation management			Mediation support		Mediation support						Metadata						Mediation exchanges	
	QOS management			QOS controls	QOS controls	QOS controls	Performance statistics					Control Reporting							
	General system management	Logging	Data for archive Configuration control Pre-processing configuration	Logging	Logging Subscription definitions	Logging Storage housekeeping configuration	Performance details		Security controls Security configuration Logging	Metadata	Control Reporting								Admin info
External to CIES	SSA	Data Notification Data read Pull data Data push																	
	CIES						Inter-CIES messaging Rerouted requests												
	Cube			Requests Subscription requests (add/mod/cancel) Reply Notification Error	Subscription service availability / cancellation notification	Requests Retrieve		Metadata Request Reply											
	Security Services								Security controls										
	Reg/Rep							Metadata											
	Mediation Service									Mediation exchanges									
	Admin Services											Admin info							

The intra-functional CIES data flows are addressed for each function, in the sections that follow. It is important to note that although some administrative management and control data flows and processing are addressed, an underlying enterprise service bus (ESB) or message-oriented middleware (MOM), which is not explicitly shown, is assumed to interconnect the various processing functions to perform all process coordination and process communications.

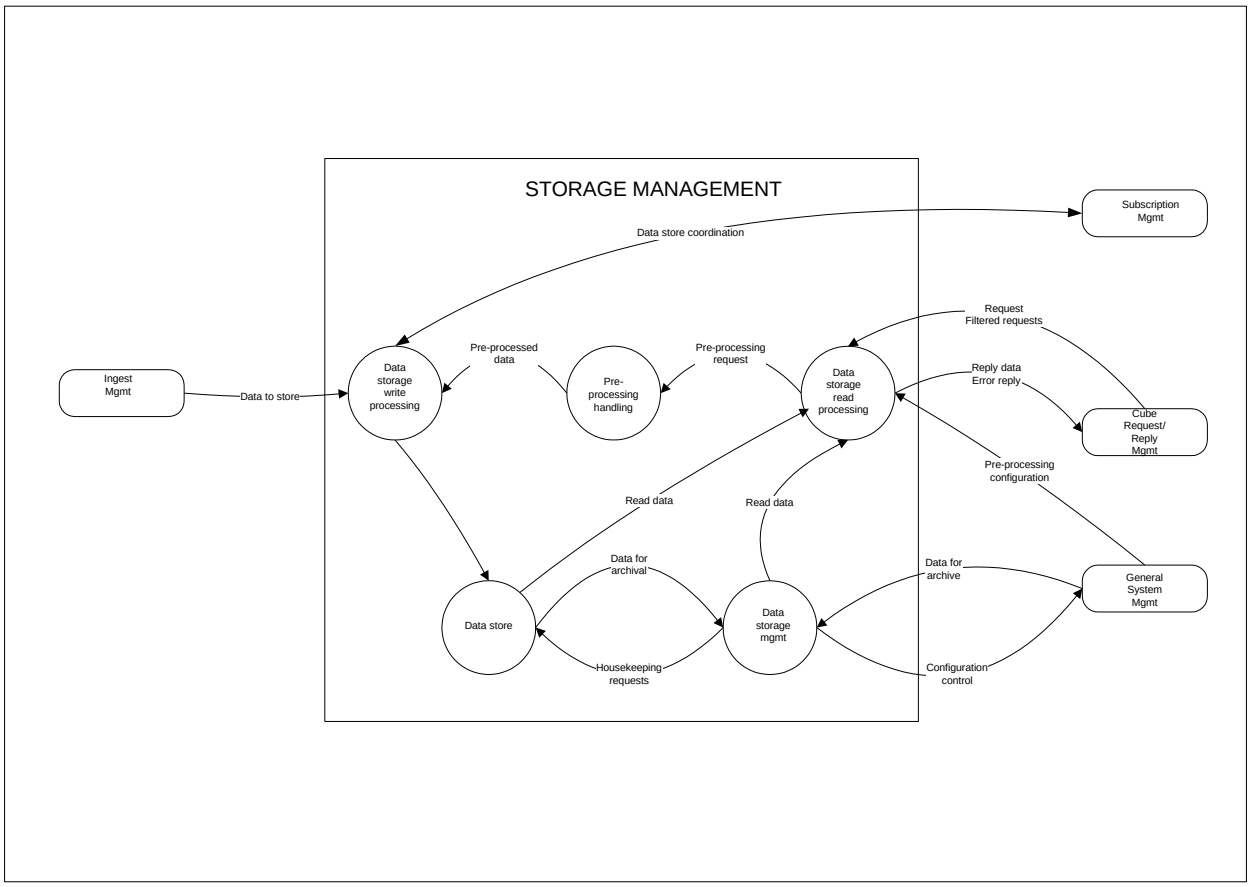
5.3.4.2.1.1 Ingest Management

The figure below presents the data flows associated with the CIES Ingest Management function.



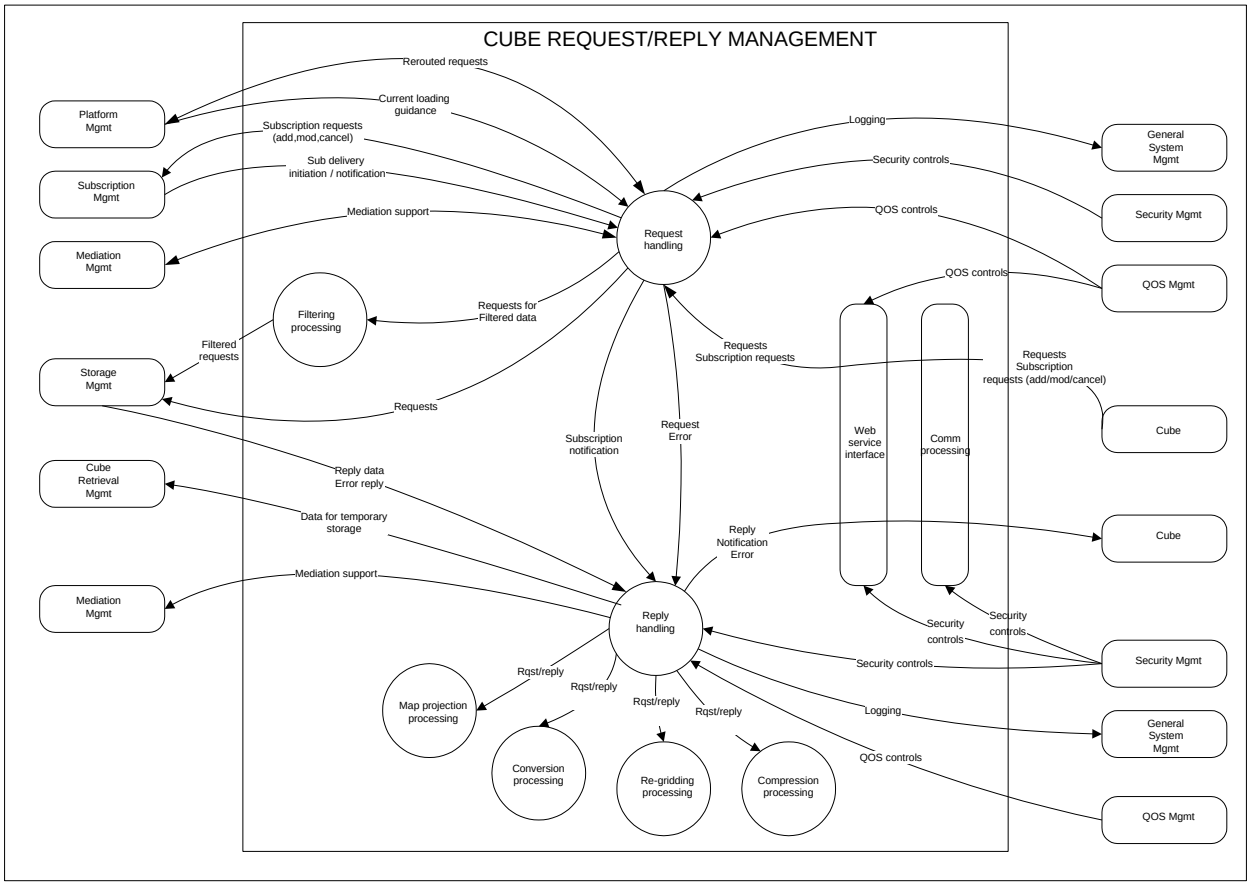
5.3.4.2.1.2 Storage Management

The figure below presents the data flows associated with the CIES Storage Management function.



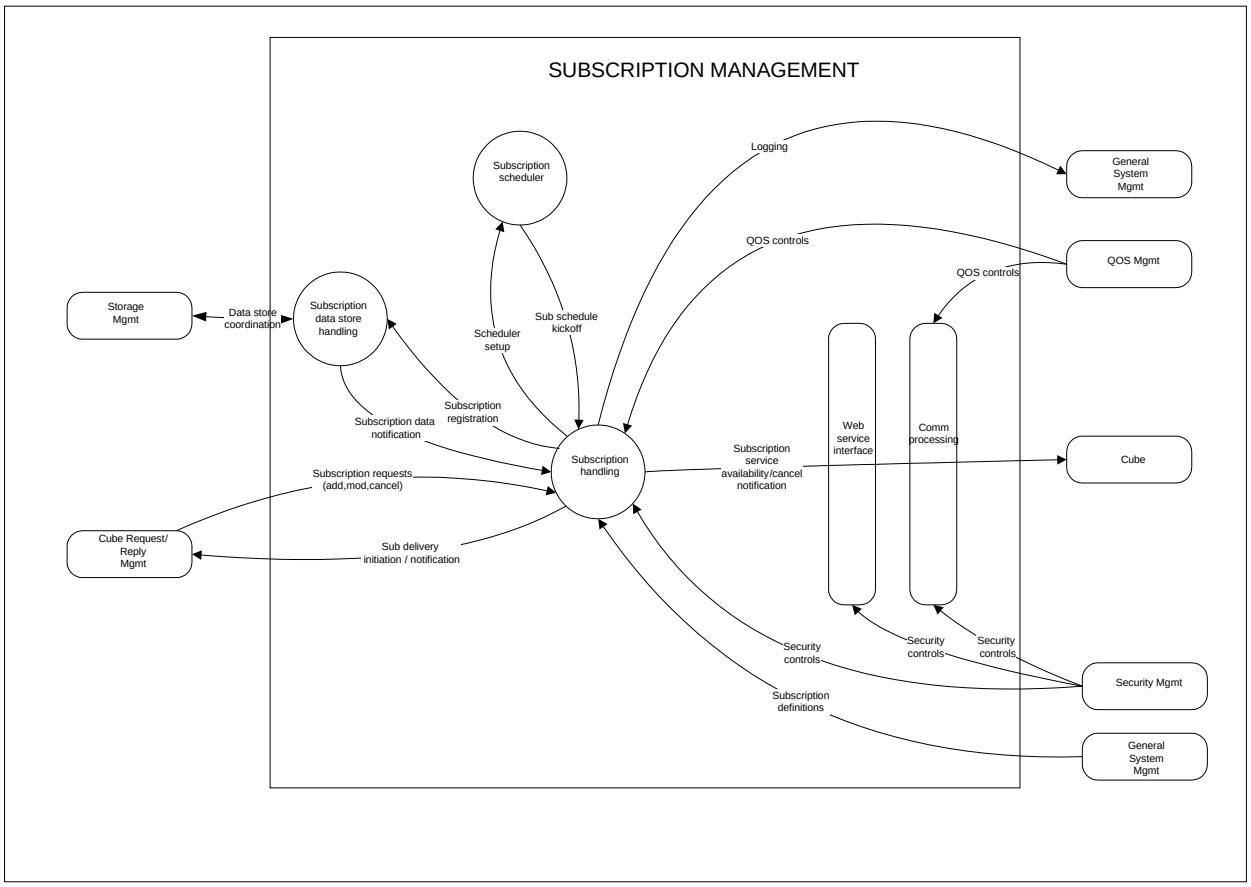
5.3.4.2.1.3 Cube Request/Reply Management

The figure below presents the data flows associated with the CIES Cube Request/Reply Management function.



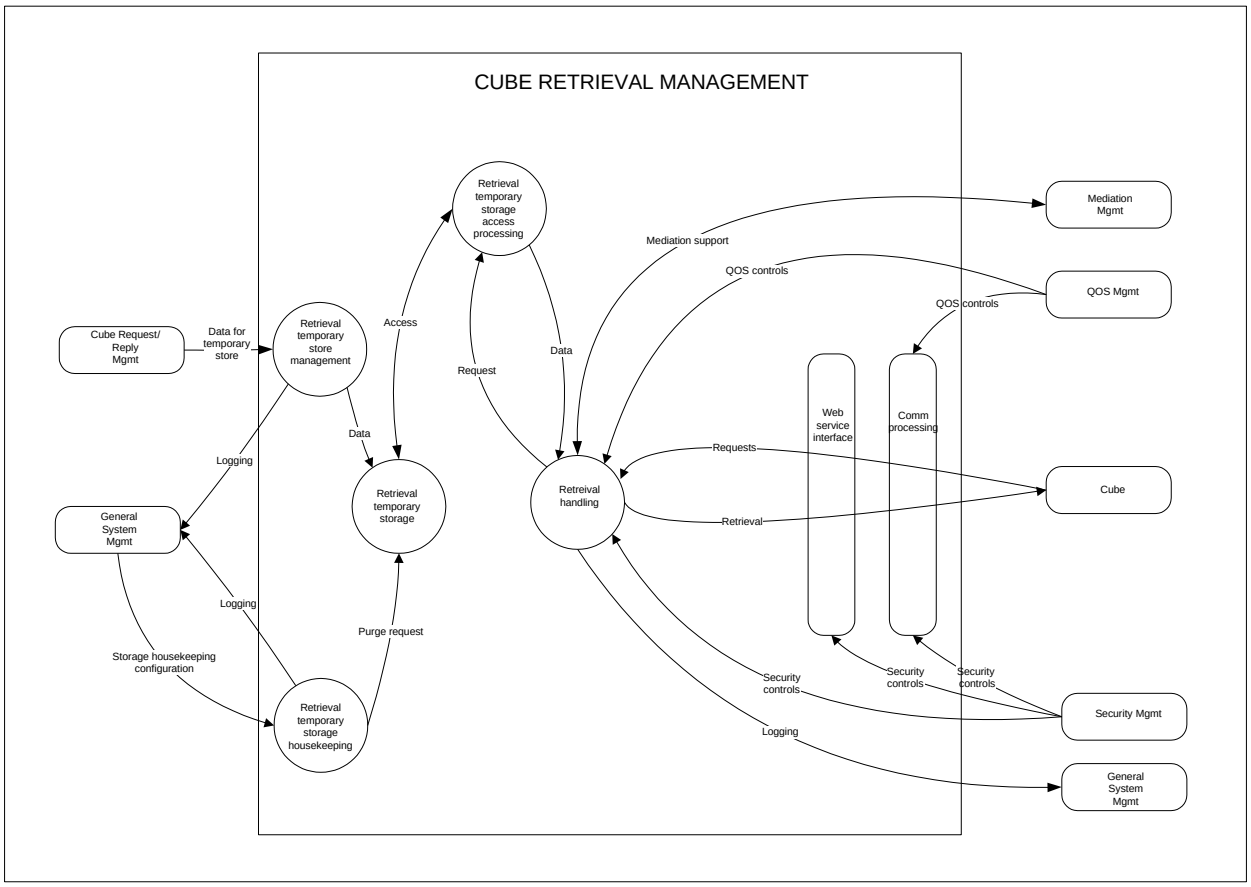
5.3.4.2.1.4 Subscription Management

The figure below presents the data flows associated with the CIES Subscription Management function.



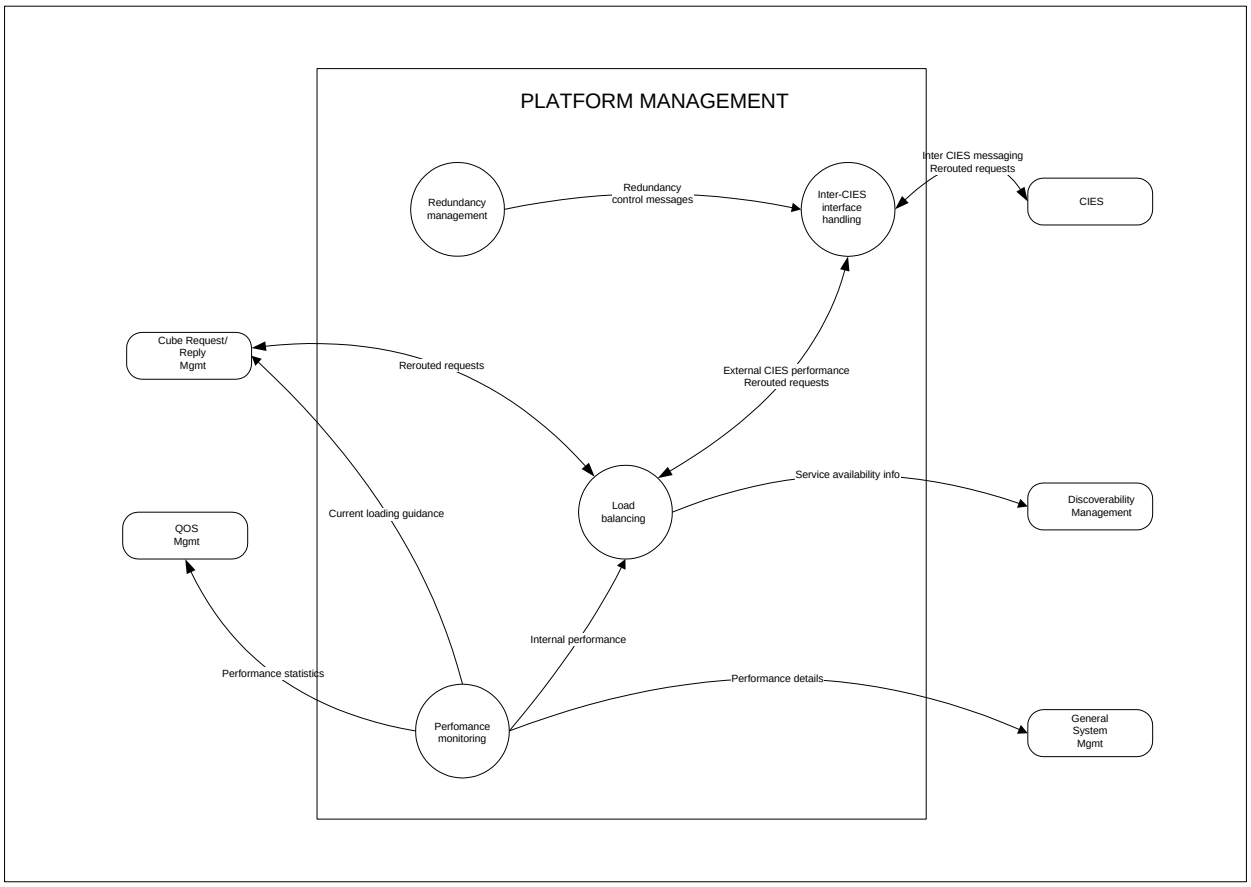
5.3.4.2.1.5 Cube Retrieval Management

The figure below presents the data flows associated with the CIES Cube Retrieval Management function.



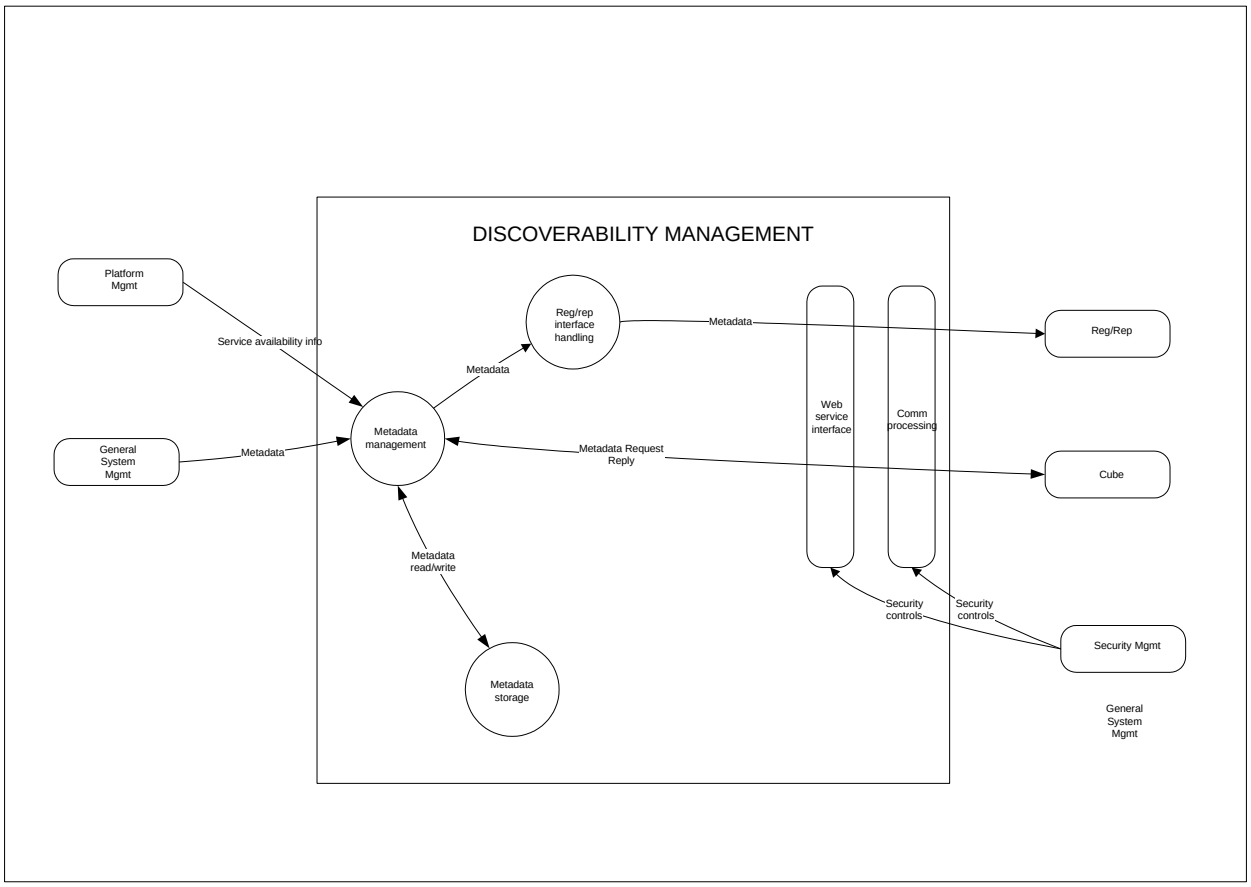
5.3.4.2.1.6 Platform Management

The figure below presents the data flows associated with the CIES Platform Management function.



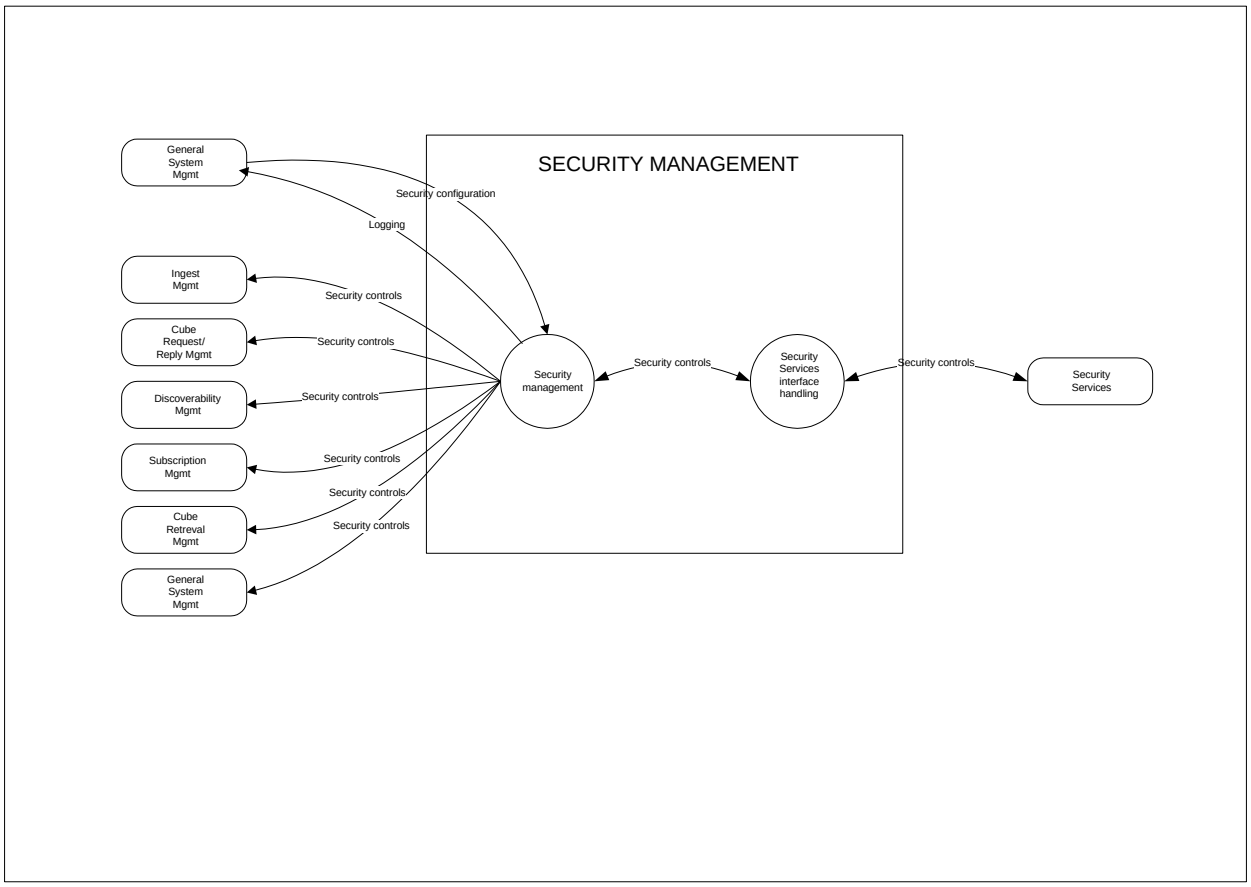
5.3.4.2.1.7 Discoverability Management

The figure below presents the data flows associated with the CIES Discoverability Management function.



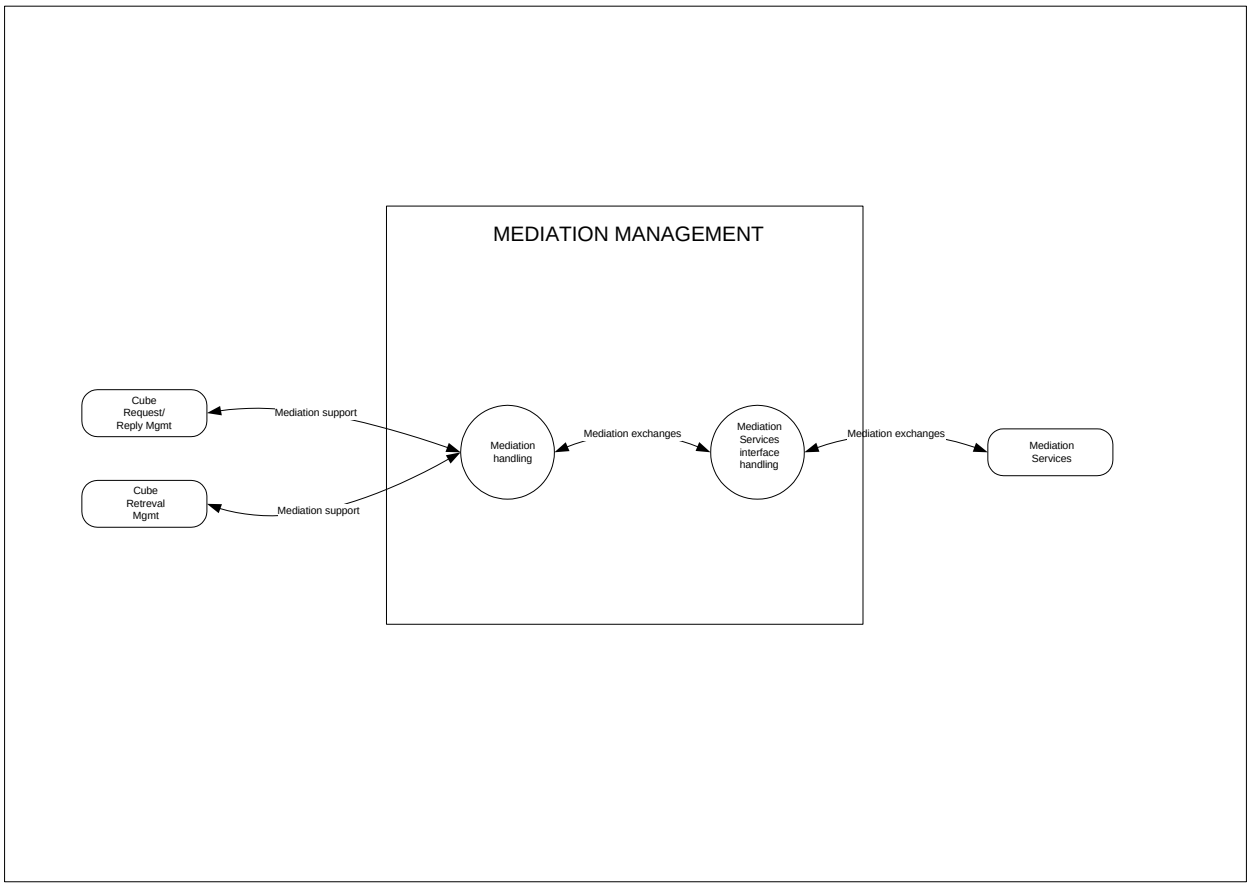
5.3.4.2.1.8 Security Management

The figure below presents the data flows associated with the CIES Security Management function.



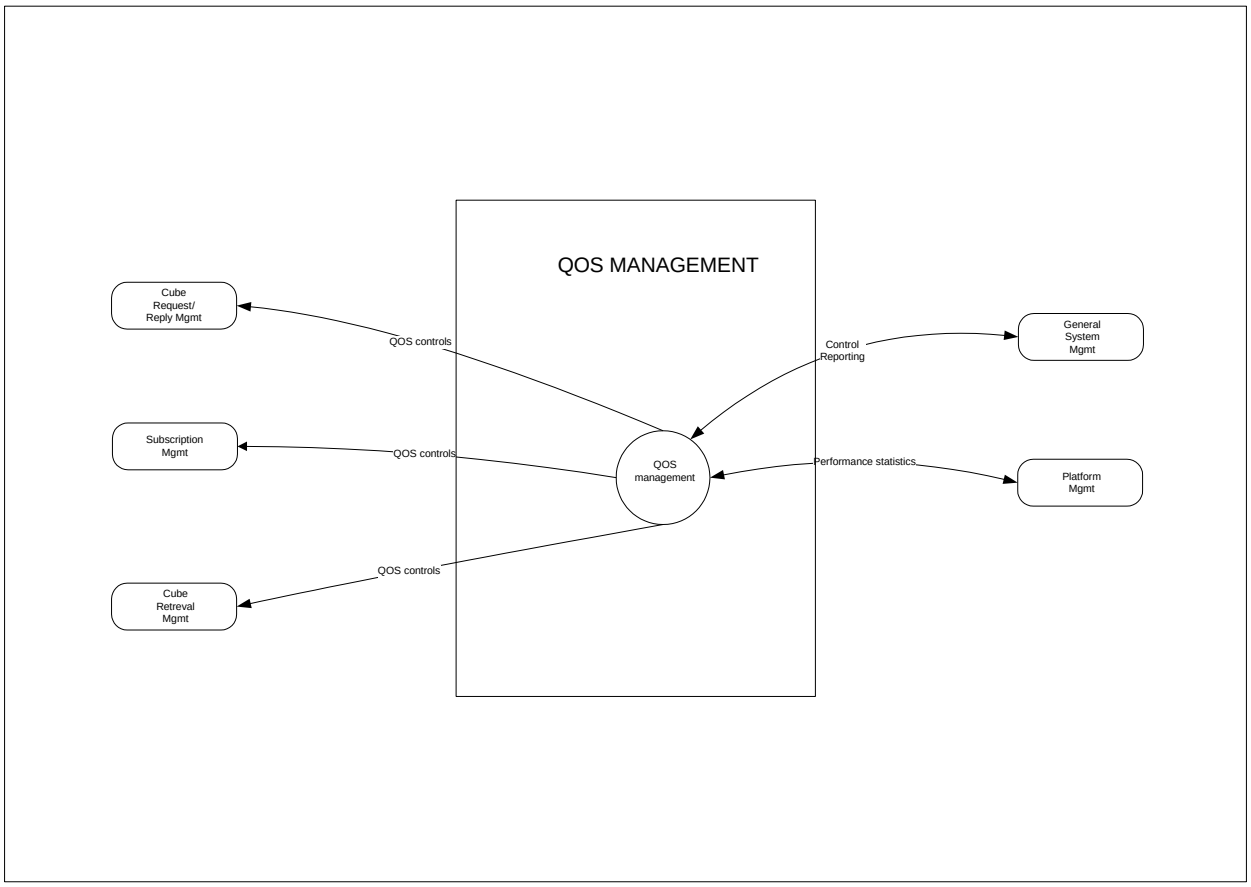
5.3.4.2.1.9 Mediation Management

The figure below presents the data flows associated with the CIES Mediation Management function.



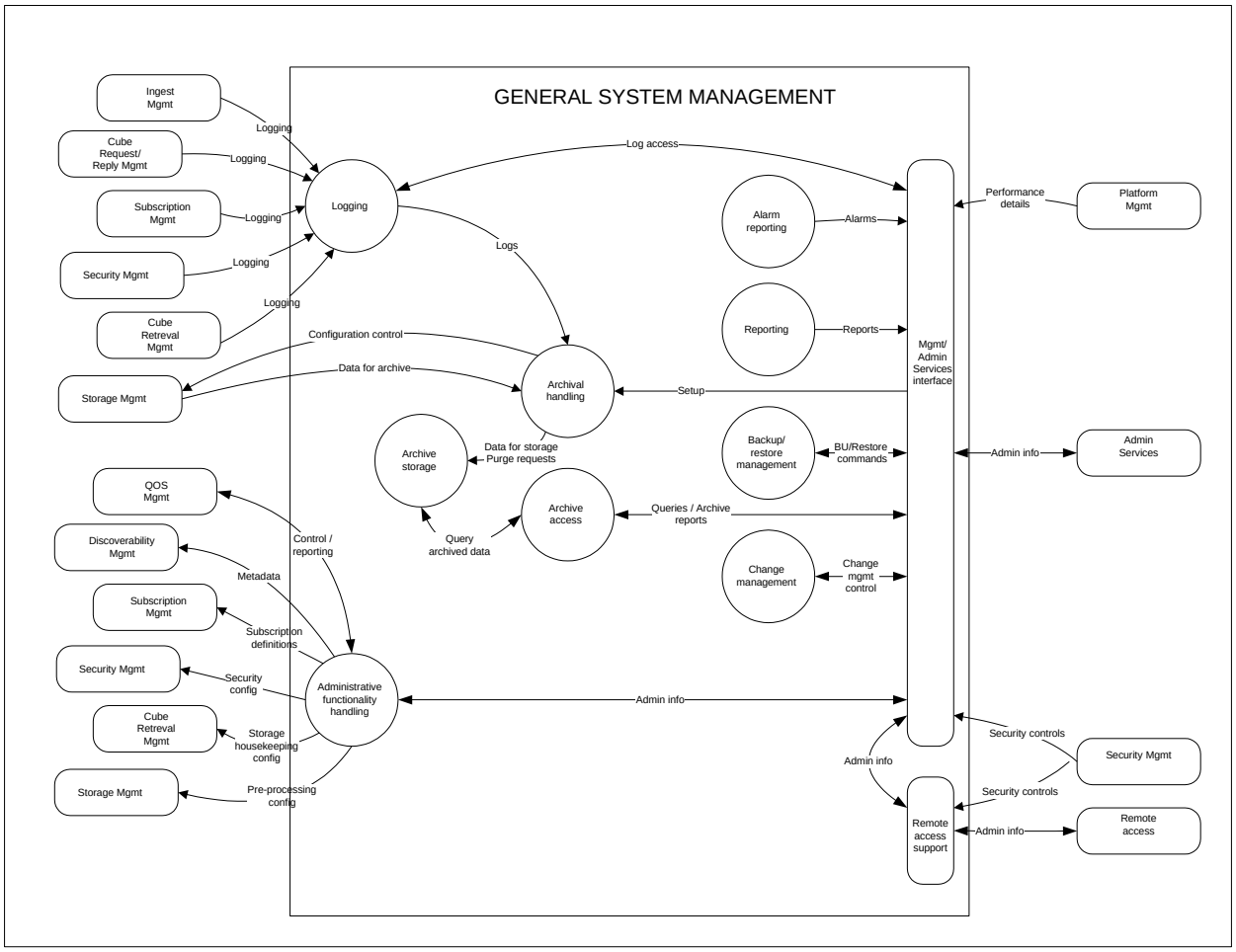
5.3.4.2.1.10 QOS Management

The figure below presents the data flows associated with the CIES QOS Management function.



5.3.4.2.1.11 General System Management

The figure below presents the data flows associated with the CIES General System Management function.



5.3.4.2.2 COES level

The matrix below presents the exchange of information between the functions supported by each COES and between a COES and external entities.

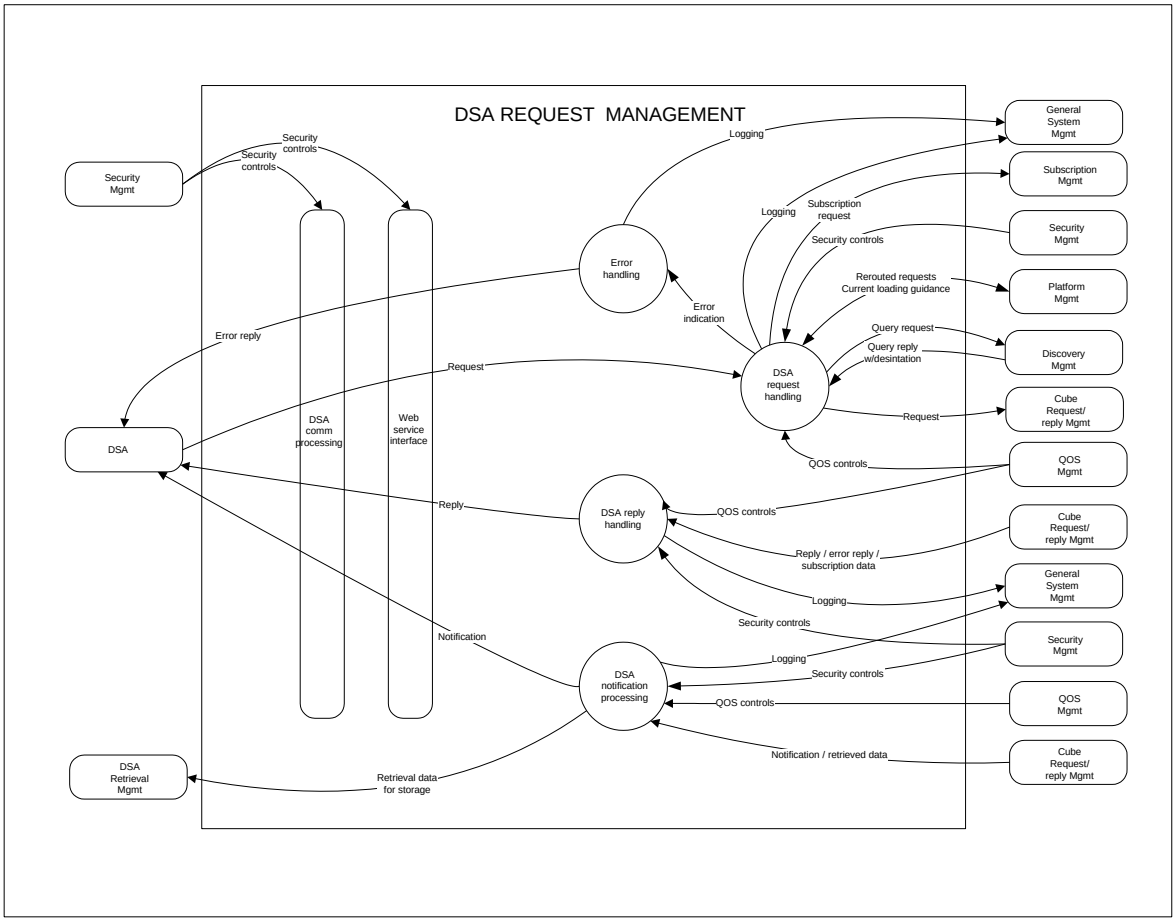
		Internal COES										External to COES						
		DSA request management	Discovery management	QOS management	Subscription management	Cube request/reply management	DSA retrieval management	Security management	Platform management	Mediation management	General system management	DSA	COES	Cube	Security Services	Mediation Services	Admin Services	Reg /Rep
Internal COES	DSA request management		Query request Query reply w/destination	QOS controls	Subscription requests	Requests Replys/errors/subscription data Notification/ retrieved data	Retrieval data for storage	Security controls	Rerouted requests Current loading guidance		Logging	Request Reply Error reply Notification						
	Discovery management	Query request Query reply w/destination						Security controls										Query Response
	QOS management	QOS controls			QOS controls	QOS controls			Performance statistics		Control/ reporting							
	Subscription management	Subscription requests		QOS controls		Subscription requests/changes/cancellation Subscription service cancellation Subscription confirmation Disaggregation coordination		Security controls			Logging Subscription service cancellation notice							
	Cube request/reply management	Requests Replys/errors/subscription data Notification/ retrieved data		QOS controls	Subscription requests/changes/cancellation Subscription service cancellation Subscription confirmation Disaggregation coordination			Security controls		Mediation support	Logging Archived responses			Request Reply/Notification Query Retrieval				
	DSA retrieval management	Retrieval data for storage						Security controls			Logging Storage housekeeping configuration	Query Retrieval						
	Security management	Security controls	Security controls		Security controls	Security controls	Security controls				Security controls Logging Security configuration				Security controls			

		Internal COES										External to COES						
		DSA request management	Discovery management	QOS management	Subscription management	Cube request/reply management	DSA retrieval management	Security management	Platform management	Mediation management	General system management	DSA	COES	Cube	Security Services	Mediation Services	Admin Services	Reg /Rep
	Platform management	Rerouted requests Current loading guidance		Performance statistics							Performance details		Inter-COES messaging Rerouted requests					
	Mediation management					Mediation support										Mediation exchanges		
	General system management	Logging		Control/ reporting	Logging Subscription service cancellation notice	Logging Archived responses	Logging Storage housekeeping configuration	Security controls Logging Security configuration	Performance details								Admin info	
External to COES	DSA	Request Reply Error reply Notification					Query Retrieval											
	COES								Inter-COES messaging Rerouted requests									
	Cube					Request Reply/Notification Query Retrieval												
	Security Services							Security controls										
	Mediation Services									Mediation exchanges								
	Admin Services										Admin info							
	Reg /Rep		Query Response															

The intra-functional COES data flows are addressed for each function, in the sections that follow. It is important to note that although some administrative management and control data flows and processing are addressed, an underlying enterprise service bus (ESB) or message-oriented middleware (MOM), which is not explicitly shown, is assumed to interconnect the various processing functions to perform all process coordination and process communications.

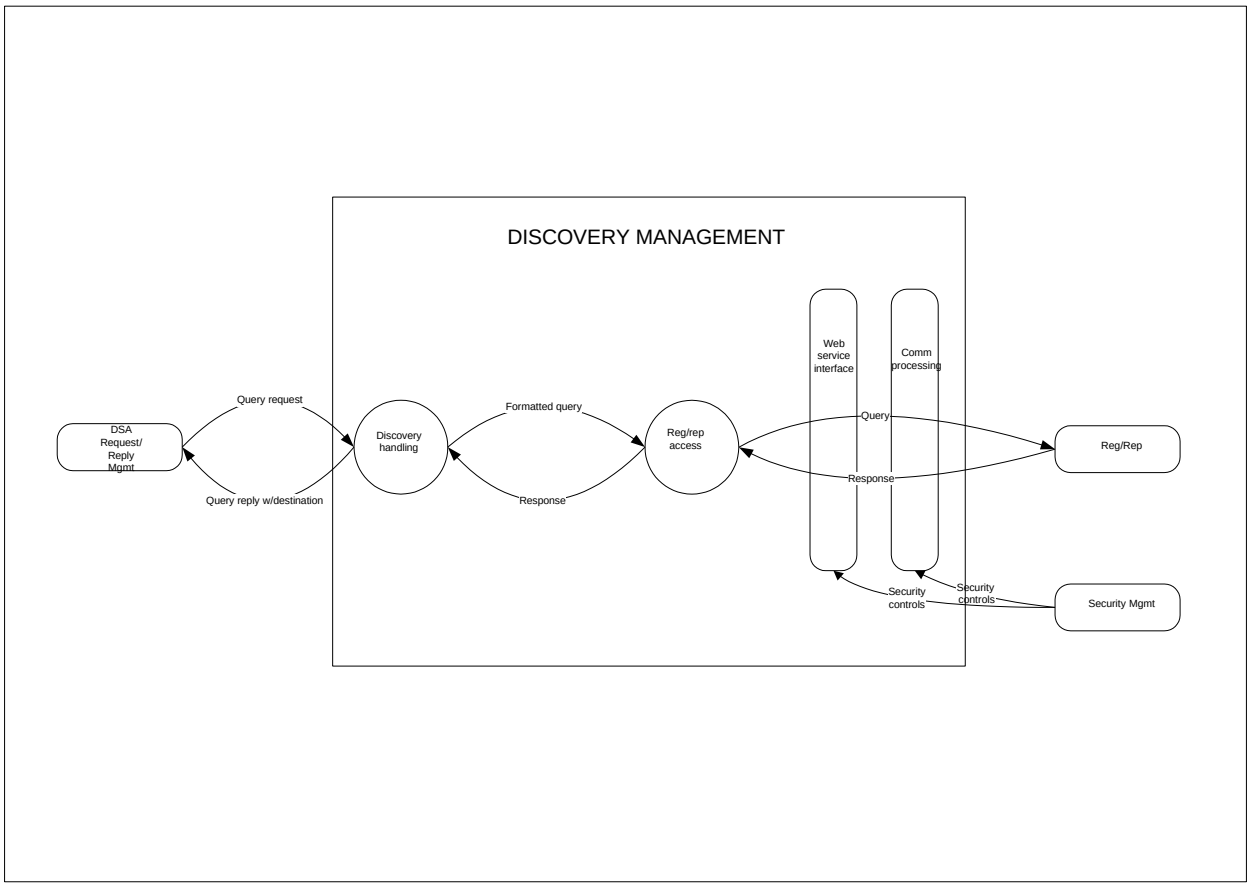
5.3.4.2.2.1 DSA Request Management

The figure below presents the data flows associated with the COES DSA Request Management function.



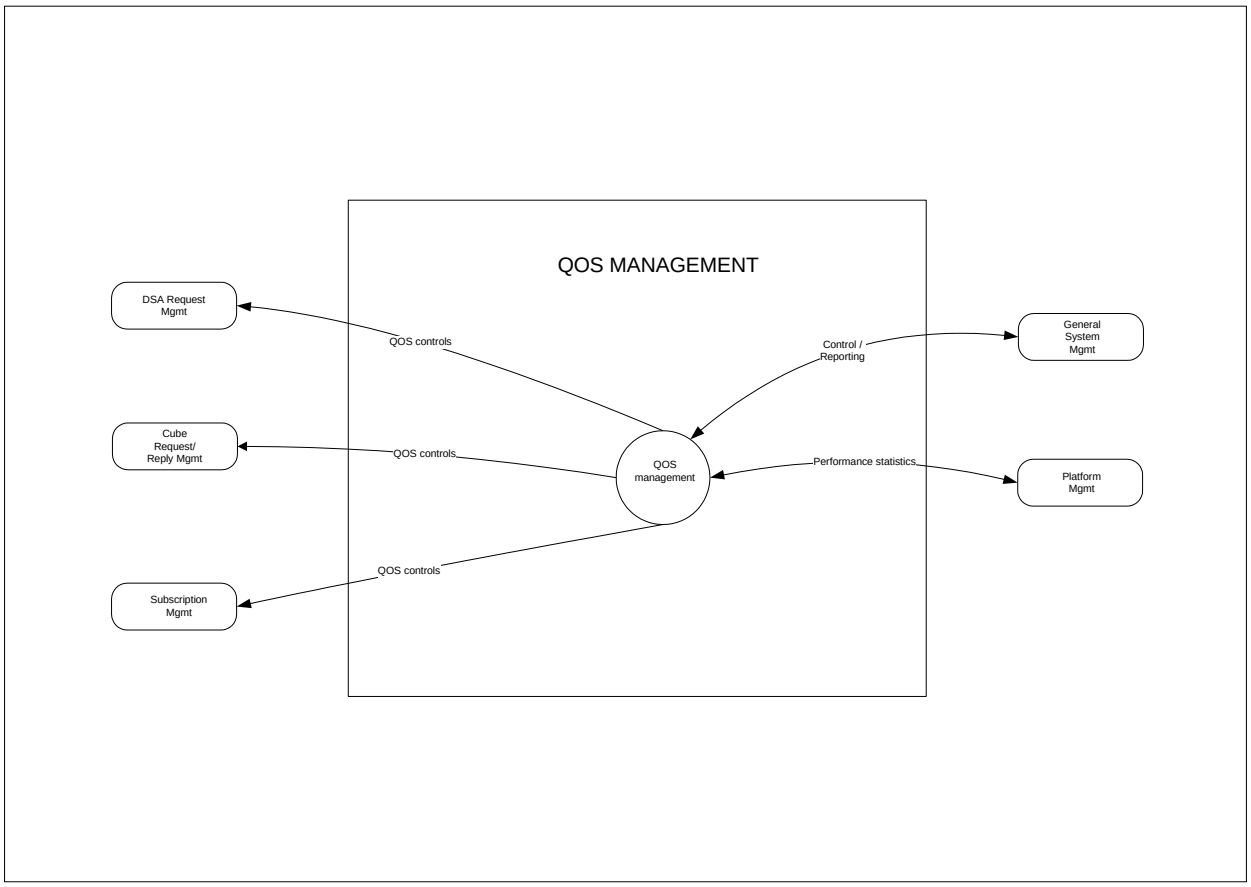
5.3.4.2.2.2 Discovery Management

The figure below presents the data flows associated with the COES Discovery Management function.



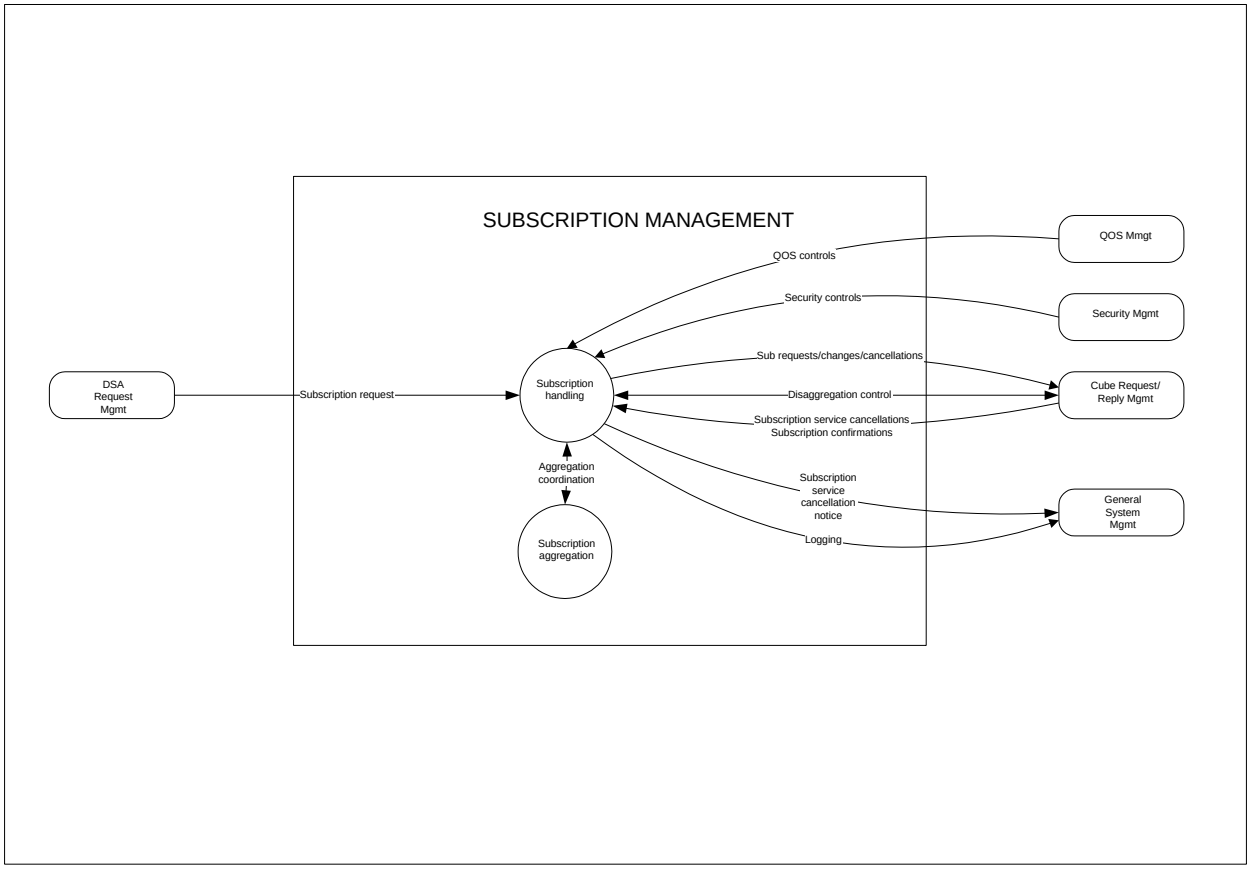
5.3.4.2.2.3 QOS Management

The figure below presents the data flows associated with the COES QOS Management function.



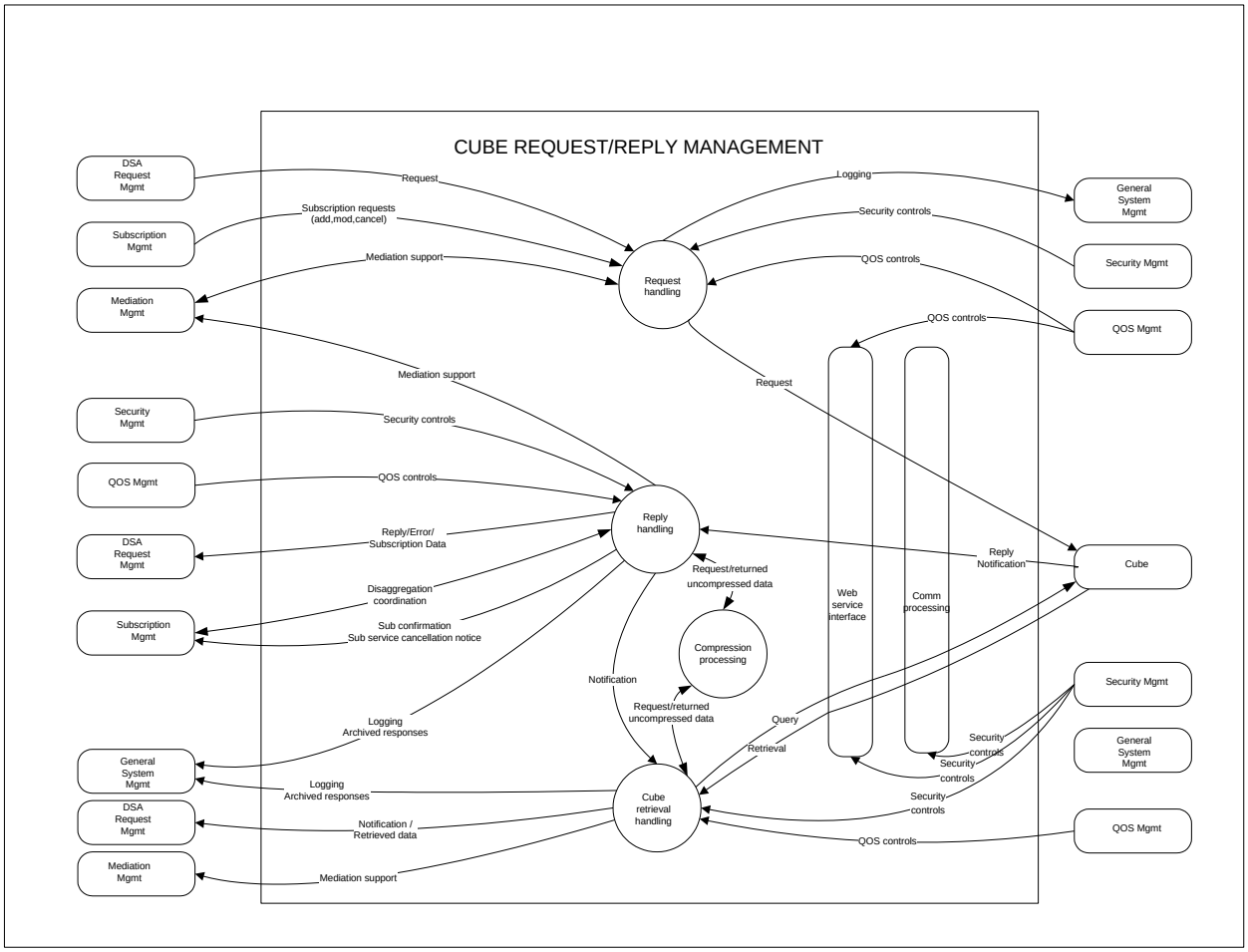
5.3.4.2.2.4 Subscription Management

The figure below presents the data flows associated with the COES Subscription Management function.



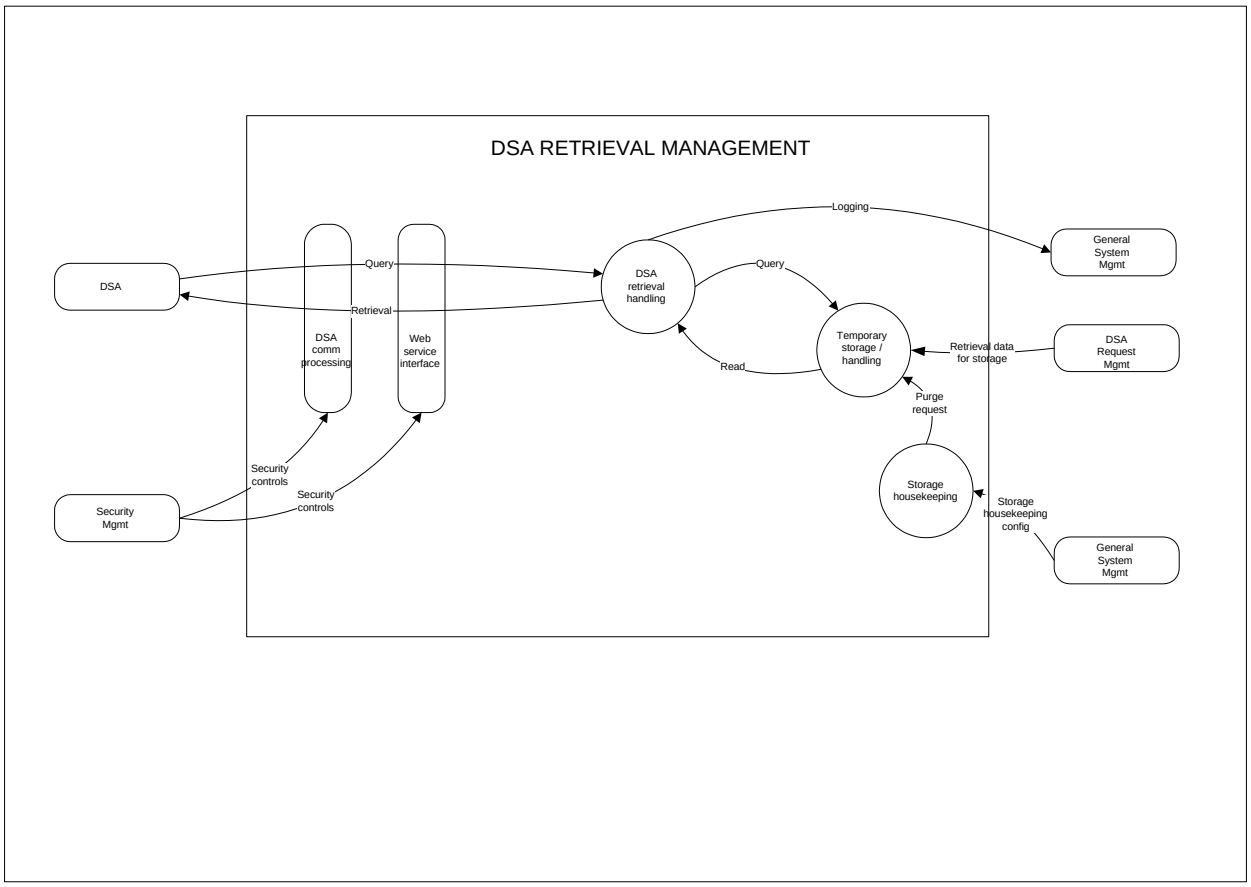
5.3.4.2.2.5 Cube Request/Reply Management

The figure below presents the data flows associated with the COES Cube Request/Reply Management function.



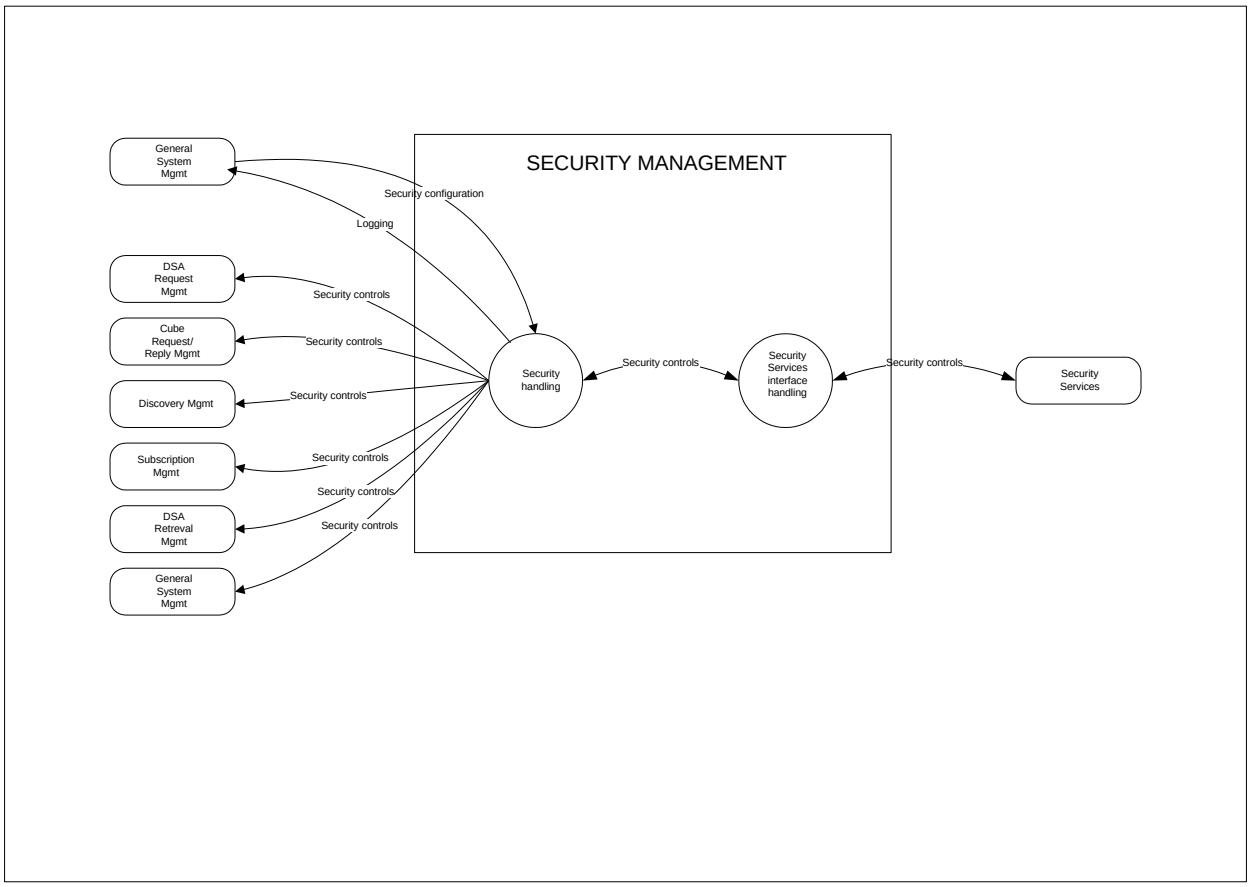
5.3.4.2.2.6 DSA Retrieval Management

The figure below presents the data flows associated with the COES DSA Retrieval Management function.



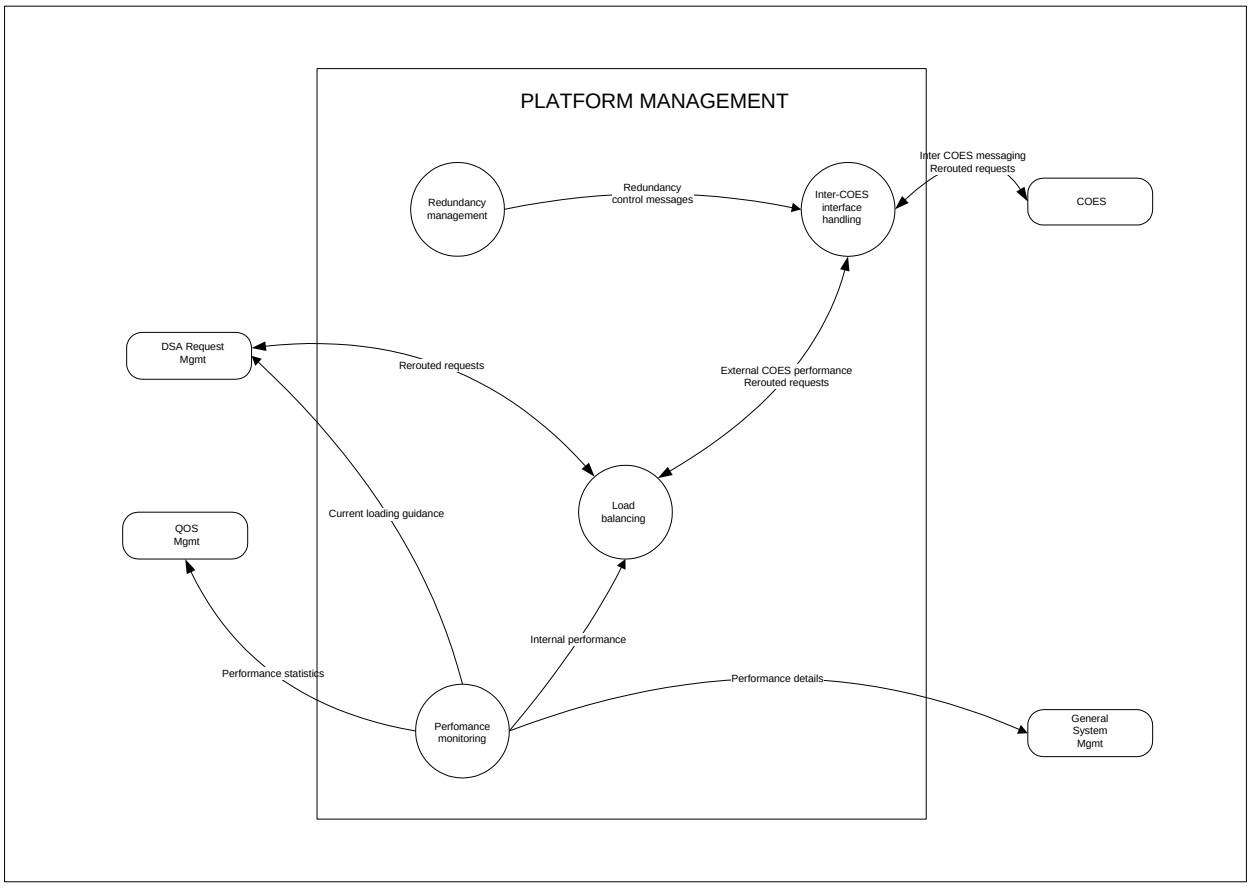
5.3.4.2.2.7 Security Management

The figure below presents the data flows associated with the COES Security Management function.



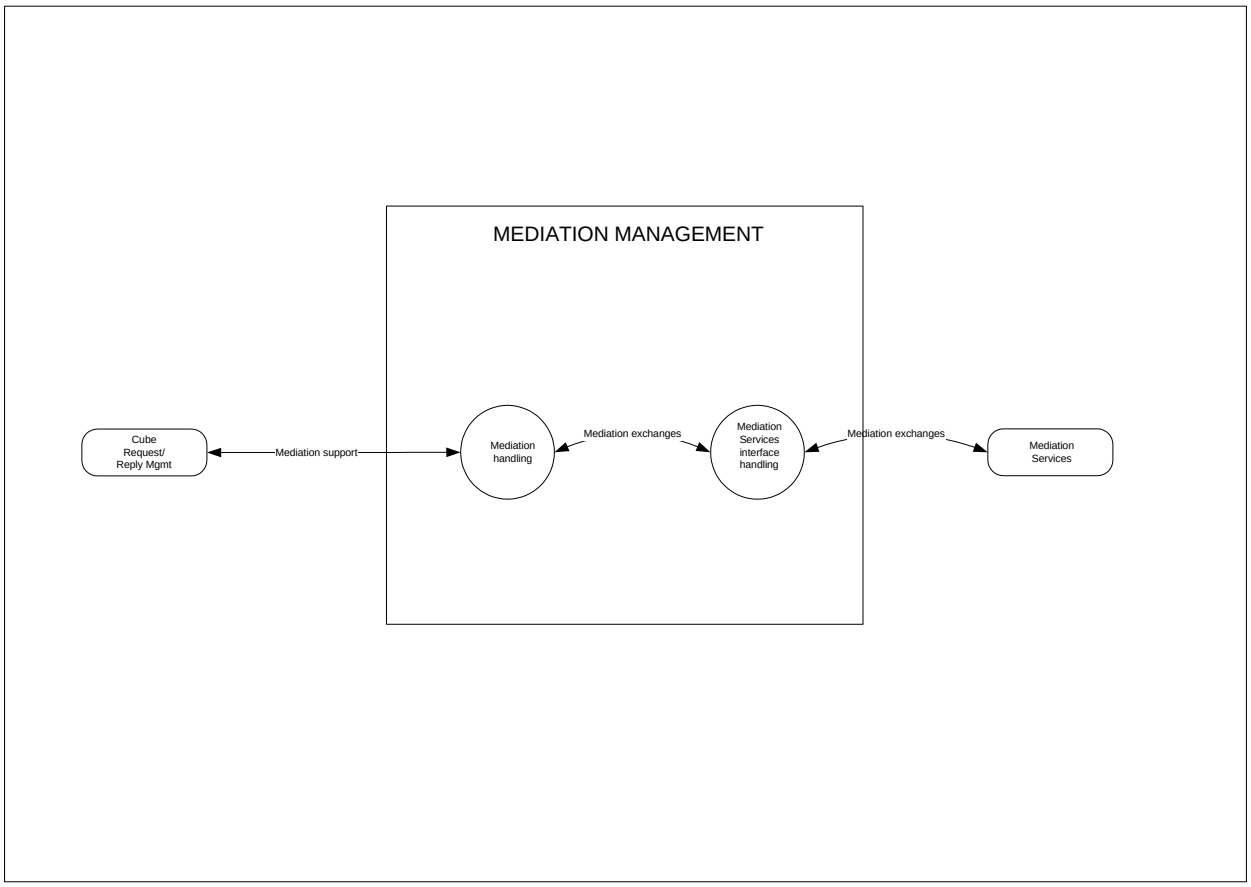
5.3.4.2.2.8 Platform Management

The figure below presents the data flows associated with the COES Platform Management function.



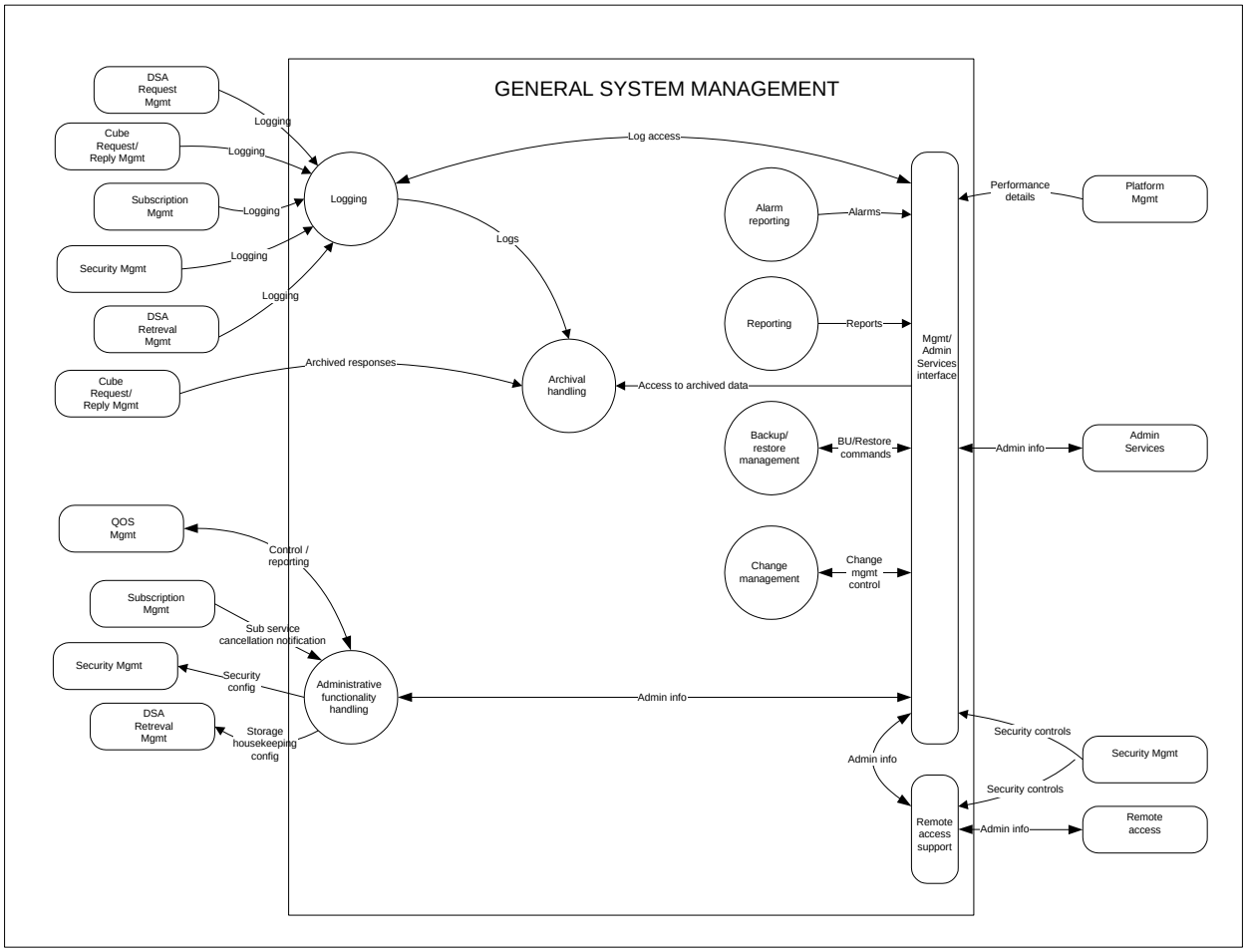
5.3.4.2.2.9 Mediation Management

The figure below presents the data flows associated with the COES Mediation Management function.



5.3.4.2.2.10 General System Management

The figure below presents the data flows associated with the COES General System Management function.



5.3.5 SV-6 Systems Data Exchange Matrix (ICDs)

Data exchange matrices depict characteristics of the data flowing between systems. Several matrices are presented below to represent all possible system interfaces. The focus of SV-6 is geared towards the implementation of system data exchange, covering system-specific details such as data type and format, and supported web services. In some cases the matrices depict the protocols necessary for the exchange of data, as well as the supported data formats.

Several matrices are presented in this section. The CIES-Cube and COES-Cube matrices, which address specific weather products/datasets exchanged via the Cube, are composed of the following columns:

- Data Group – Represents products/data that have a common originating system or model.
- Data – Product/data name.

- Source System – The system that produces the data, and will be considered the origin of data for the Cube.
- Data Type – Either gridded or non-gridded.
- Data Format – Format that is used to store the data.
- MEP Supported – Message Exchange Protocol supported for the data.
  - R/R – adhoc Request/Response.
  - P/S – Publish/Subscribe.
- Supported Web Service – WCS/WFS RI's or JMBL.
- Filterability – Depending on the supported web service, data can be spatially and temporally queried.
- Map Projection – Available map projections for data.
- Comments – comments on information.

Note: Most of the information in the matrices are still blank or TBD. Efforts are continuing to define this interface details and coordinate then with the FAA architecture developers..

5.3.5.1 CIES

The following shows data exchanges between the CIESs and the systems they interface with.

5.3.5.1.1 CIES – Cube

The products listed below are appropriate for the IOC timeframe. The matrix is a superset of the FAA's *IOC Product Flow Sheet,* the EI's Teams *IOC Product Sheet*. The products can be accessed with an ad-hoc request/reply and Cube requesters can also set up a subscription to obtain them from the CIES. Additional products / datasets are being considered for future NextGen inclusion.

Data Group	Data	Source System	Data Type	Data Format	MEP supported	Supported Web Service	Filterability (time,space)	Map Proj.	Comments
NEXRAD level 3	Product 2	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 3	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 20	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 38	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 41	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 57	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 59	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 66	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 75	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 90	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 93	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 134	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 135	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 141	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	Product 143	TBD	gridded	netCDF	R/R P/S	WCSRI	time,space		
	AP Removed Low Layer Composite Reflect Max 4km resolution, 230km	TBD			R/R P/S				
	Composite Reflectivity AP mitigated 4km resolution, 460km Range 16 level	TBD			R/R P/S				
	Composite Reflectivity 4km resolution, 460km Range 8 Level	TBD			R/R P/S				
	Low Layer Composite Reflectivity Max 4km resolution, 230km	TBD			R/R P/S				
	Base Reflectivity 1km resolution 230km Range 16 Level Tilt 1	TBD			R/R P/S				
	Storm Structure 248km Range	TBD			R/R P/S				
	Storm Track Information 248km Range Build 10	TBD			R/R P/S				
	Severe Weather Probability 4km resolution 230km Range	TBD			R/R P/S				
	Tornado Vortex Signature 124km Range Build 10	TBD			R/R P/S				
GOES E Imagery data	Visible (1 km)	TBD			R/R P/S				
	Infrared Channel 1 (4 km)	TBD			R/R P/S				
	Infrared Channel 2 (4 km)	TBD			R/R P/S				
	Infrared Channel 3 (4 km)	TBD			R/R P/S				
	Infrared Channel 4 (4 km)	TBD			R/R P/S				
	Infrared Channel 6 (8 km)	TBD			R/R P/S				
	Water Vapor (4 km)	TBD			R/R P/S				

GOES W Imagery data	Visible (1 km)	TBD			R/R P/S				
	Infrared Channel 1 (4 km)	TBD			R/R P/S				
	Infrared Channel 2 (4 km)	TBD			R/R P/S				
	Infrared Channel 3 (8 km)	TBD			R/R P/S				
	Infrared Channel 4 (4 km)	TBD			R/R P/S				
	Infrared Channel 5 (4 km)	TBD			R/R P/S				
	Water Vapor (8 km)	TBD			R/R P/S				
WRF-RR Model Data	WRF-RR winds	NOMADS			R/R P/S				
	WRF-RR temps	NOMADS			R/R P/S				
HRRR Model Data	15-Minute VIL	NOMADS			R/R P/S				
	15-Minute Echo Tops	NOMADS			R/R P/S				
	Pressure	NOMADS			R/R P/S				
MADIS surface obs.	METARS	MADIS			R/R P/S				
	Mesonet	MADIS			R/R P/S				
	Maritime	MADIS			R/R P/S				
Model data	UKMET Thin GRIB messages	NOMADS			R/R P/S				
	GFS Thin Grids GRIB messages	NOMADS			R/R P/S				
	WRF-RR	NOMADS			R/R P/S				
NAM Model data	NAM V GRIB messages	NOMADS			R/R P/S				
MDCRS data	Reports				R/R P/S				
GTG	Forecast	ADDS			R/R P/S				
	Analysis	ADDS			R/R P/S				
CIP	Severity	ADDS			R/R P/S				
	Supercooled Large Droplets	ADDS			R/R P/S				
	Probability	ADDS			R/R P/S				
FIP	1-12 Severity	ADDS			R/R P/S				
	1-12 hr Supercooled Large Droplets	ADDS			R/R P/S				
	1-12 hr Probability	ADDS			R/R P/S				
NCVA	TBD	ADDS			R/R P/S				
Textual Products	PIREP		Text		R/R P/S				
	TAF		Text		R/R P/S				
	AIRMET		Text		R/R P/S				
	CCFP		Text		R/R P/S				
	ADA-Alarm/Alert Administrative Message (Urgent Notification)		Text		R/R P/S				
	ADM-Alert Administrative Message		Text		R/R P/S				
	ADR-NWS Administrative Message (External)		Text		R/R P/S				
	FTM-Free Text Message		Text		R/R P/S				
	AIR-International AIRMET		Text		R/R P/S				
	ARP-AIREP		Text		R/R P/S				

AWW-Aviation Weather Warning		Text		R/R P/S				
CFP-Collaborative Convective Forecast		Text		R/R P/S				
CWA-Center (CWSU) Weather Advisory		Text		R/R P/S				
CWS-Center (CWSU) Weather Statement		Text		R/R P/S				
FTA-Terminal Forecast		Text		R/R P/S				
MIS-Meteorological Impact Statements		Text		R/R P/S				
OAV-Other Aviation Products		Text		R/R P/S				
PIR-Pilot Report & Urgent PIREPS		Text		R/R P/S				
PRC-State Pilot Report Collective		Text		R/R P/S				
TAF-International Terminal Forecast		Text		R/R P/S				
TAP-Terminal Alerting Product		Text		R/R P/S				
WA1-WA9-AIRMET (Northeast U.S., Southeast U.S., North Central U.S., South Central U.S., U.S. Rocky Mountains, U.S. West Coast, Juneau, Alaska, Anchorage, Alaska, Fairbanks, Alaska)		Text		R/R P/S				
18A-18-hour Wintem		Text		R/R P/S				
24A-24-hour Wintem		Text		R/R P/S				
AFD-Area Forecast Discussion		Text		R/R P/S				
AFP-Area Forecast Products		Text		R/R P/S				
EFP-3- to 5-day Extended Forecast		Text		R/R P/S				
EOL-Avg 6-10 day Weather Outlook		Text		R/R P/S				
FA1-FA9-Aviation (Northeast U.S., Southeast U.S., North Central U.S., South Central U.S., U.S. Rocky Mountain, U.S. West Coast, Juneau, Alaska, Fairbanks, Alaska)		Text		R/R P/S				
FD0-24-hr FD Wind Aloft (45k & 53k)		Text		R/R P/S				
FD1-6-hr Winds Aloft Forecast		Text		R/R P/S				
FD2-12-hr Winds Aloft Forecast		Text		R/R P/S				

	FD3-24-hr Winds Aloft Forecast		Text		R/R P/S				
	FOF-Upper Wind Fallout Forecast		Text		R/R P/S				
	FOH-ETA FOUS FRZ & RH		Text		R/R P/S				
	FTP-FOUS Prog Max/Min Temperature /Probability of Precipitation Guidance		Text		R/R P/S				
	FWC-FOUS Wind/Cloud Guidance		Text		R/R P/S				
	LFP-Local Forecast		Text		R/R P/S				
	NOW-Short Term Forecast		Text		R/R P/S				
	OFA-Offshore Aviation Area Forecast		Text		R/R P/S				
	OFF-Offshore Forecast		Text		R/R P/S				
	QPF-Quantitative Precip Forecast		Text		R/R P/S				
	SFD-State Forecast Discussion		Text		R/R P/S				
	SFP-State Forecast		Text		R/R P/S				
	SGW-Plain Language Significant Wx Forecast		Text		R/R P/S				
	SMF-Smoke Management WX Forecast		Text		R/R P/S				
	ZFP-Zone Forecast		Text		R/R P/S				
	CFW-Coastal Flood Warning		Text		R/R P/S				
	CWF-Coastal Waters Forecast		Text		R/R P/S				
	GLF-Great Lakes Forecast		Text		R/R P/S				
WARP Textual Products	HSF-High Seas Forecast		Text		R/R P/S				
	MAW-Marine Advisory Warning		Text		R/R P/S				
	MWS-Marine Weather Statement		Text		R/R P/S				
	NSH-Nearshore Marine Forecast		Text		R/R P/S				
	SMW-Special Marine Warning		Text		R/R P/S				
	STW-Storm Warning		Text		R/R P/S				
	ABV-Rawinsonde Data Above 100mb		Text		R/R P/S				
	BOY-Buoy-reports Synoptic & Nonsynoptic		Text		R/R P/S				
	CLI-Climate Reports		Text		R/R P/S				
	FZL-Freezing Level Data		Text		R/R P/S				
	HYD-24-Hour Precipitation Obs		Text		R/R P/S				
	MAN-Rawinsonde Observation Mandatory Levels		Text		R/R P/S				

MTR-Domestic METAR Report		Text		R/R P/S				
SGL-Rawinsonde Observation Significant Levels		Text		R/R P/S				
SHN-Surface Ship Report Non-Synoptic Time		Text		R/R P/S				
SHP-Surface Ship Report Synoptic Time		Text		R/R P/S				
SPE-Satellite Precipitation		Text		R/R P/S				
SSI-Intermediate Surface Synoptic Observation		Text		R/R P/S				
SSM-Main Surface Synoptic Observation		Text		R/R P/S				
SSO-Satellite Sounding Obs		Text		R/R P/S				
ESF-Flood Potential Outlook		Text		R/R P/S				
FFA-Flash Flood Watch		Text		R/R P/S				
FFS-Flash Flood Statement		Text		R/R P/S				
FFW-Flash Flood Warning		Text		R/R P/S				
FLS-Flood Statement		Text		R/R P/S				
FLW-Flood Warning		Text		R/R P/S				
LSR-Local Storm Report		Text		R/R P/S				
NPW-Nonprecipitation Warning		Text		R/R P/S				
SAW-Aviation Severe Weather Watch		Text		R/R P/S				
SEL-Severe Local Storm Watch & Watch Cancellation Message		Text		R/R P/S				
SIG-International SIGMET		Text		R/R P/S				
SPS-Special Weather Statement		Text		R/R P/S				
STA-Network & Severe Weather Statistics		Text		R/R P/S				
SVR-Severe Thunderstorm Warning		Text		R/R P/S				
SVS-Severe Weather Statement		Text		R/R P/S				
TOR-Tornado Warning		Text		R/R P/S				
WS5-WS6-SIGMET (U.S. Rocky Mountains, U.S. West Coast)		Text		R/R P/S				
WSW-Winter Weather Wrn/Watch/Adv		Text		R/R P/S				
WWA-Watch Status Report		Text		R/R P/S				
CHG-Computer Hurricane Guidance		Text		R/R P/S				
TCD-Tropical Cyclone Discussion		Text		R/R P/S				
TCE-Tropical Cyclone Position								

	Estimate		Text		R/R P/S				
	TCM-Marine/Aviation Tropical Cyclone Advisory		Text		R/R P/S				
	TWD-Tropical Weather Discussion		Text		R/R P/S				
	TWO-Tropical Weather Outlook & Summary		Text		R/R P/S				
	FWF-Fire Weather Forecast		Text		R/R P/S				
	HRR-Hourly Weather Roundup		Text		R/R P/S				
	NWX-National Weather Summary		Text		R/R P/S				
	PMD-Prognostic Map Discussion		Text		R/R P/S				
	PNS-Public Information Statement		Text		R/R P/S				
	RWS-Regional Weather Statement		Text		R/R P/S				
	SCS-Selected Cities Summary		Text		R/R P/S				
	SYN-Weather Synopsis		Text		R/R P/S				
	TAV-Travelers Forecast Table		Text		R/R P/S				
	VAA-Volcanic Ash Advisory		Text		R/R P/S				
	Mosaic Base Reflectivity (2km resolution with maximum reflectivity method)				R/R P/S				
	Mosaic Base Reflectivity (4km resolution with maximum reflectivity method)				R/R P/S				
	Mosaic Base Reflectivity (2km resolution with optimal mosaic method)				R/R P/S				
	Mosaic Base Reflectivity (4km resolution with optimal mosaic method)				R/R P/S				
	Composite Reflectivity Mosaic 0-60k ft. (4km resolution with maximum reflectivity method)				R/R P/S				
	Composite Reflectivity Mosaic 0-60k ft. (4km resolution with optimal mosaic method)				R/R P/S				
	Digital VIL Mosaic (2km resolution)				R/R P/S				
	Digital VIL Mosaic (4km resolution)				R/R P/S				
	Enhanced Echo Top Mosaic (2km								

	resolution)				R/R P/S				
Mosaic Data	Enhanced Echo Top Mosaic (4km resolution)				R/R P/S				
	Echo Top Mosaic				R/R P/S				
	Low Layer Reflectivity Mosaic 0-24kft (low altitude)				R/R P/S				
	Layer Composite Reflectivity Mosaic 24-60 kft (highest altitude)				R/R P/S				
	Layer Composite Reflectivity Mosaic 33-60 kft (super high altitude)				R/R P/S				
	National Base Reflectivity Mosaic 2 km				R/R P/S				
	National Base Reflectivity Mosaic 8km				R/R P/S				
	National Composite Reflectivity Mosaic 4km				R/R P/S				
	National Composite Reflectivity Mosaic 8km				R/R P/S				
	National Echo Top Mosaic 4km				R/R P/S				
	National Echo Top Mosaic 8km				R/R P/S				
	National Digital VIL Mosaic 2km				R/R P/S				
	National Digital VIL Mosaic 8km				R/R P/S				
	National Enhanced Echo Top Mosaic 2 km				R/R P/S				
	National Enhanced Echo Top Mosaic 8km				R/R P/S				
	NMCGPH92E-6-Hour Quantitative Precipitation Forecast (First 6-Hour Period)		graphic		R/R P/S				
	NMCGPHL2P-12-Hour Instantaneous Precipitation Fcst (NA)		graphic		R/R P/S				
	NMCGPH93E-6-Hour Quantitative Precipitation Forecast (Second 6-Hour Period)(NA)		graphic		R/R P/S				
	NMCGPH94Q-24-Hour (Day 1) Quantitative Precipitation Forecast (NA)		graphic		R/R P/S				
	NMCGPHL4P-24-Hour Instantaneous Precipitation Fcst (NA)		graphic		R/R P/S				

	NMCGPHL6P-36-Hour Instantaneous Precipitation Fcst (NA)		graphic		R/R P/S				
	NMCGPHL8P-48-Hour Instantaneous Precipitation Fcst (NA)		graphic		R/R P/S				
	NMCGPHP0P-Observed 24-Hour Precipitation Plot (NA)		graphic		R/R P/S				
	NMCGPHP0S-Observed Snow Cover (NA)		graphic		R/R P/S				
	NMCGPHI0P-Precipitable Water Contour Analysis at Observation Time		graphic		R/R P/S				
	NMCGPHL2W-12-Hour Weather Depiction CIGS/VSBYS – Low Level Forecast (North America)		graphic		R/R P/S				
	NMCGPHL4W-24-Hour Weather Depiction CIGS/VSBYS – Low Level Forecast (North America)		graphic		R/R P/S				
	NMCGPHP0W-Observed Weather Depiction Analysis (Plot) (NA)		graphic		R/R P/S				
	NMCGPH90W-Observed Weather Depiction Analysis (Contour) (NA)		graphic		R/R P/S				
	NMCGPH94O-Convective Outlook – Day One (1) (US)		graphic		R/R P/S				
	NMCGPH98O-Convective Outlook – Day Two (2) (US)		graphic		R/R P/S				
NWS Graphic Data	NMCGPH7WG-24H TJ 700 NVD12(NA) (HVD-NET VERT DSPLCMT)		graphic		R/R P/S				
	NMCGPH7XG-36H TJ 700 NVD12 (NA)		graphic		R/R P/S				
	NMCGPH7YG-48H TJ 700 NVD12 (NA)		graphic		R/R P/S				
	NMCGPH90I-MSL Isobar Analysis at 3-Hour Intervals (North America)		graphic		R/R P/S				
	NMCGPH9JH-DAY3 FNT-ISOBAR (NH)		graphic		R/R P/S				
	NMCGPH92F-12-hr Surface Front and MSL Pressure Forecast (NA)		graphic		R/R P/S				

	NMCGPH94F-24-hr Surface Front and MSL Pressure Forecast (NA)		graphic		R/R P/S				
	NMCGPH96F-36-hr Surface Front and MSL Pressure Forecast (NA)		graphic		R/R P/S				
	NMCGPH98F-48-hr Surface Front and MSL Pressure Forecast (NA)		graphic		R/R P/S				
	NMCGPHL2F-12-Hour Freezing Level Analysis (NA)		graphic		R/R P/S				
	NMCGPHL4F-24-Hour Freezing Level Analysis (NA)		graphic		R/R P/S				
	NMCGPHP0X-Observed Max Temp Plot for 12 Hours Ending HH		graphic		R/R P/S				
	NMCGPHP0N-Observed MIN Temp Plot for 12 Hours Ending HH		graphic		R/R P/S				
	NMCGPH90X-NORM MAX TMP ANL		graphic		R/R P/S				
	NMCGPH90N-NORM MIN TMP ANL		graphic		R/R P/S				
	NMCGPH90F-Map of Surface Fronts at 3-Hour Intervals (North America)		graphic		R/R P/S				
	NMCGPH9AM-SFC GEOST WND (NA)		graphic		R/R P/S				
	NMCGPH9AV-SFC GEOST VOT (NA)		graphic		R/R P/S				
	NMCGPH93P-DAY3 MX/MN-POP A (NA) (A=ANOMALY)		graphic		R/R P/S				
WARP Image Products	GOES_E_PSN_IR11,2-NA, IA, S0, S1, S2, S3, S4				R/R P/S				
	GOES_E_PSN_IR21,2-NA, IA, S0, S1, S2, S3, S4				R/R P/S				
	GOES_E_PSN_IR41,2-NA, IA, S0, S1, S2, S3, S4				R/R P/S				
	GOES_E_PSN_VIS1,2-NA, IA, S0, S1, S2, S3, S4				R/R P/S				
	GOES_E_PSN_WV1,2-NA, IA, S0, S1, S2, S3, S4				R/R P/S				
	GOES_W_PSN_IR11,2-NA, IA, S0, S1, S2, S3				R/R P/S				
	GOES_W_PSN_IR21-NA, IA, S0, S1, S2, S3				R/R P/S				

	GOES_W_PSN_IR41-NA, IA, S0, S1, S2, S3				R/R P/S				
	GOES_W_PSN_VIS1-NA, IA, S0, S1, S2, S3				R/R P/S				
	GOES_W_PSN_WV1-NA, IA, S0, S1, S2, S3				R/R P/S				
	LIGHTNING-CONUS, ALASKA				R/R P/S				
POES Imagery Data	1J1F-JUNEAU				R/R P/S				
	1AF-ALASKA_AF				R/R P/S				
	1F2F-FAIRBANKS2				R/R P/S				
	1ABF-BERING				R/R P/S				
	1AKF-ALASKA_AK				R/R P/S				
	1F1F-FAIRBANKS1				R/R P/S				
	1ACF-ARCTIC				R/R P/S				
	1KKF-KAMCHATKA				R/R P/S				
	4J1F-JUNEAU				R/R P/S				
	4AF-ALASKA_AF				R/R P/S				
	4F2F-FAIRBANKS2				R/R P/S				
	4ABF-BERING				R/R P/S				
	4AKF-ALASKA_AK				R/R P/S				
	4A1-ANCHORAGE				R/R P/S				
	4A2-ALEUTIANS				R/R P/S				
	4F1F-FAIRBANKS1				R/R P/S				
	4ACF-ARCTIC				R/R P/S				
	4KKF-KAMCHATKA				R/R P/S				
	4GVF-LARGE_GOES				R/R P/S				
	4AV1F-ALASKA_VOLCANO1				R/R P/S				
	4AV2F-ALASKA_VOLCANO2				R/R P/S				

The table above depicted specific product/data flows, and protocols supported on a product by product basis. The table below shows a higher level view of the data flow between CIESs and the Cube. Instead of analyzing each product, the table below shows this generalized exchanged information, including currently envisioned the communication protocols and supported data formats associated for each information exchange (where known).

Exchanged information	Communication Protocols	Data Formats
Requests / replies / errors	Web Services:	
	WFS	WXXM
	WCS	NetCDF4 / GRIB2
	WMS	TBD
	JMBL	JMBL XML / GRIB / others
Subscription Requests (add/mod/cancel)	Web Services:	
	WFS	WFS (with extension)
	WCS	WCS (with extension)
	WMS	TBD
	JMBL	TBD

Request / retrieval	TBD	TBD
Notification	WS-Notification	TBD
Subscription service availability/cancellation notification	WS-Notification	TBD
Metadata request / reply	Web Services: WFS WCS WMS JMBL	 WFS (GetCapabilities/Describe Features) WCS (GetCapabilities/Describe Coverages) TBD TBD

5.3.5.1.2 CIES – SSA

The SSA will communicate with the CIES primary through a web service interface wherever possible. However, gridded data may be exchanges via non-web services (for example, via FTP). The exchanged information supports moving products/data from the SSA to CIES. There a few options for the communication protocols, the ones listed are appropriate, but not final. The supported data formats are growing and will aim towards supporting all legacy formats in NOAA's portion of the Cube.

Exchanged information	Communication Protocols	Data Formats
Data	Web Services	

	WFS	WXXM
	WCS	NetCDF3/4, HDF4/5, GRIB1/2, GINI, NEXRAD level 2/3, McIDAS, others?
	WMS	TBD
	JMBL	JMBL XML / GRIB / others
Data pull / data push / data read	FTP, others?	NetCDF3/4, HDF4/5, GRIB1/2, GINI, NEXRAD level 2/3, McIDAS, others?
Notification	WS - Notification	TBD

5.3.5.1.3 CIES – Reg/Rep

The CIES will populate the Reg/Rep with metadata and will communicate with the Reg/Rep through a web service interface. Details on the 'Metadata' are still TBD along with the data formats the protocol will support. The 'Metadata' will be published to the Reg/Rep exposing the services available on the CIES for discovery purposes.

Exchanged information	Communication Protocols	Data Formats
Metadata	Web Service (WSDL via SOAP?)	See Metadata Guidelines for formats

5.3.5.1.4 CIES – Security Components

The intention is that the CIES will communicate with external Security Services through a web service interface. Details on the 'security controls' is still TBD along with the data formats the protocol will support. For ad hoc request/reply and subscription data retrieval originating from the CIES, security controls may be needed from the Security Services. The security controls play an important role in the internal functions of the CIES as well.

Exchanged information	Communication Protocols	Data Formats
Security Controls	Web Service (WS-Trust, SAML, WS-Security Policy,WS-Security?)	TBD

5.3.5.1.5 CIES – Administrative Services

The intention is that the CIES will communicate with external Administrative Services through a web service interface. Details on the specific administrative information are TBD along with the data formats that will be supported.

Exchanged information	Communication Protocols	Data Formats
Administrative information	Web Service (type – TBD)	TBD

5.3.5.1.6 CIES – Mediation Services

The intention is that the CIES will communicate with external Mediation Services through a web service interface. Details on the specific mediation exchanges are TBD along with the data formats that will be supported. In general, mediation exchanges provide for the translation of data formats and web services between otherwise disparate systems.

Exchanged information	Communication Protocols	Data Formats
Mediation Exchanges	Web Service (type – TBD)	TBD

5.3.5.1.7 CIES – CIES

This interface exists as mechanism to engage in a load balancing/redundant implementation with other CIES. The CIES will exchange information to other CIESs if it is reaching its maximum load, and reroute any requests from Cube participants to the available CIES.

Exchanged information	Communication Protocols	Data Formats
Rerouted requests	Same as CIES to Cube interfaces	Same as CIES to Cube formats
Inter-CIES messaging	Web Service (type – TBD)	TBD

5.3.5.2 COES

The following sections address data exchanges between the COESs and the systems they interface with.

5.3.5.2.1 COES – Cube

The products listed below are appropriate for the IOC timeframe. The matrix is a superset of the FAA's *IOC Product Flow Sheet,* the EI's Teams *IOC Product Sheet*. The products can be accessed by the COES with an ad-hoc request/reply and the COES can also set up a subscription to obtain them. Additional products / datasets are being considered for future NextGen inclusion.

Data Group	Data	Source System	Data Type	Data Format	MEP supported	Supported Web Service	Filterability (time,space)	Map Proj.	Comments
TDWR data	Compressed Base Data (Doppler Base Data)	TBD			R/R P/S				
	Compressed Low-Pulse Repetition Frequency (PRF) Base Data (Surveillance-Only Base Data)	TBD			R/R P/S				
Canadian Weather Radar	Conventional Volume (CONVOL) Unfiltered Reflectivity (ZT) Product	TBD			R/R P/S				
RASP Surface Observations	One Minute Observations	TBD			R/R P/S				
Lightning Data	Lightning Detection Data (FAA Contractor)				R/R P/S				
	Sensor Up/Down Messages				R/R P/S				
Reflectivity Mosaics	Composite Reflectivity Mosaic (dsr_cr)				R/R P/S				
	Highest Layer Composite Reflectivity Mosaic (dsr_crhi)				R/R P/S				
	Low Layer Composite Reflectivity Mosaic (dsr_crlo)				R/R P/S				
	Super High Layer Composite Reflectivity Mosaic (dsr_lrms)				R/R P/S				
Observation and Warning data	METARS				R/R P/S				
	SPECI				R/R P/S				
	SIGMETs				R/R P/S				
TDWR Level II base data	Compressed Base Data to Tape Message				R/R P/S				
	Compressed Base Data to Tape Low PRF Scan Message				R/R P/S				
	Airport Wind Data				R/R P/S				
	LLWAS III Data to Tape Message				R/R P/S				
TDWR level II products	DFU Alphnumeric Product				R/R P/S				
	DFU Airport Wind Product				R/R P/S				
	DFU Graphic Gust Front Product				R/R P/S				
	DFU Graphic Microburst Product				R/R P/S				
	DFU Precipitation Product				R/R P/S				
	Current Valid Object Table				R/R P/S				
	DFU Airport List Message				R/R P/S				
	End of Scan Message				R/R P/S				
LLWAS	LLWAS Airport Winds				R/R P/S				
	LLWAS Runway Winds				R/R P/S				
	LLWAS Microburst Alert				R/R P/S				
	LLWAS Windshear Alert				R/R P/S				
ASR-9	ASR-9 Weather Channel				R/R P/S				
Convective	Storm VIL Forecast (2-8 hours)				R/R P/S				
	VIL Mosaic Data Quality Flags (2-8 hours)				R/R P/S				
	VIL Phase Forecast (2-8 hours)				R/R P/S				
	Echo Tops Forecast (2-8 hours)				R/R P/S				
	WAF Forecast (2-8 hours)				R/R P/S				
	Uncertainty Estimates (2-8 hours)				R/R P/S				
	Probabalistic Forecast (2-8								

Weather Products (0-2 hours)	hours)				R/R P/S				
	Precipitation VIL Contours (Standard Mode) (2-8 hours)				R/R P/S				
	VIL Contours (Winter Mode) (2-8 hours)				R/R P/S				
	Echo Tops Contours (2-8 hours)				R/R P/S				
	Forecast Accuracy : Echo Tops (2-8 hours)				R/R P/S				
	Forecast Accuracy : Standard Precip (2-8 hours)				R/R P/S				
	Forecast Accuracy : Winter Precip (2-8 hours)				R/R P/S				
IT WS products	Microburst TRACON Map				R/R P/S				
	Gust Front TRACON Map				R/R P/S				
	Gust Front ETI				R/R P/S				
	Terminal Winds Profile				R/R P/S				
	Tornado Detections				R/R P/S				
	Tornado Alert				R/R P/S				
	Configured Alerts				R/R P/S				
	Microburst ATIS				R/R P/S				
	Wind Shear ATIS				R/R P/S				
	Terminal Weather Text				R/R P/S				
	Airport Lightning Warning				R/R P/S				
	AP Status				R/R P/S				
	AP Indicated Precipitation				R/R P/S				
	Precipitation 5nm				R/R P/S				
	Precipitation TRACON				R/R P/S				
	Long-Range VIL				R/R P/S				
	SM_SEP 5nm				R/R P/S				
	SM_SEP TRACON				R/R P/S				
	SM_SEP LR				R/R P/S				
	Hazard Text 5nm				R/R P/S				
	Hazard Text TRACON				R/R P/S				
	Hazard Text LR				R/R P/S				
	VIL Forecasts				R/R P/S				
	Forecast Accuracy				R/R P/S				
	VIL Forecast Contours				R/R P/S				

The table above depicted specific product/data flows, and protocols supported on a product by product basis. The table below shows a higher level view of the data flow between COESs and the Cube. Instead of analyzing each product, the table below shows this generalized exchanged information, including currently envisioned the communication protocols and supported data formats associated for each information exchange (where known).

Exchanged information	Communication Protocols	Data Formats
Requests / replies / errors	Web Services:	
	WFS	WXXM
	WCS	NetCDF4 / GRIB2
	WMS	TBD
	JMBL	JMBL XML / GRIB / others
Subscription Requests (add/mod/cancel)	Web Services:	
	WFS	WFS (with extension)
	WCS	WCS (with extension)
	WMS	TBD
	JMBL	TBD
Request / retrieval	TBD	TBD

Notification	WS-Notification	TBD
Subscription service availability/cancellation notification	WS-Notification	TBD

5.3.5.2.2 COES – DSA

The DSA will communicate with the COES primarily through web service interfaces. The exchanged information pertains to the DSA requesting data from Cube and the COES providing the data in its reply. The exchanged information covers requests/replies, notification of data, any errors, and query/retrieval results. The communications protocols will be similar to that of the SSA-CIES. The DSA decoder is capable of decoding the received data from the COES into the above listed supported data formats. Also, a non-Web service, such as FTP, can be used for retrieval of data**.**

The SSA will communicate with the CIES primary through a web service interface wherever possible. However, gridded data may be exchanges via non-web services (for example, via FTP). The exchanged information supports moving products/data from the SSA to CIES. There a few options for the communication protocols, the ones listed are appropriate, but not final. The supported data formats are growing and will aim towards supporting all legacy formats in NOAA's portion of the Cube.

Exchanged information	Communication Protocols	Data Formats
Requests / replies / errors	Web Services:	
	WFS	WXXM
	WCS	NetCDF4 / GRIB2
	WMS	TBD
	JMBL	JMBL XML / GRIB / others

Subscription Requests (add/mod/cancel)	Web Services:	
	WFS	WFS (with extension)
	WCS	WCS (with extension)
	WMS	TBD
	JMBL	TBD
Query / retrieval	FTP, others?	NetCDF3/4, HDF4/5, GRIB1/2, GINI, NEXRAD level 2/3, McIDAS, others?
Notification	WS-Notification	TBD

5.3.5.2.3 COES – Reg/Rep

The COES will obtain metadata from the Reg/Rep and will communicate with the Reg/Rep through a web service interface. Details on metadata are addressed in more details in the Metadata Guidelines document.

Exchanged information	Communication Protocols	Data Formats
Metadata Query / response	Web Service (WSDL via SOAP?)	See Metadata Guidelines for formats

5.3.5.2.4 COES – Security Components

The intention is that the COES will communicate with external Security Services through a web service interface. Details on the 'security controls' is still TBD along with the data formats the protocol will support. For ad hoc request/reply and subscription data retrieval originating from the COES, security controls may be needed from the Security Services. The security controls play an important role in the internal functions of the COES as well.

Exchanged information	Communication Protocols	Data Formats
Security Controls	Web Service (WS-Trust, SAML, WS-Security Policy,WS-Security?)	TBD

5.3.5.2.5 COES – Admin Services

The intention is that the COES will communicate with external Administrative Services through a web service interface. Details on the specific administrative information are TBD along with the data formats that will be supported.

Exchanged information	Communication Protocols	Data Formats
Administrative information	Web Service (type – TBD)	TBD

5.3.5.2.6 COES – Mediation Services

The intention is that the COES will communicate with external Mediation Services through a web service interface. Details on the specific mediation exchanges are TBD along with the data formats that will be supported. In general, mediation exchanges provide for the translation of data formats and web services between otherwise disparate systems.

Exchanged information	Communication Protocols	Data Formats
Mediation Exchanges	Web Service (type – TBD)	TBD

5.3.5.2.7 COES – COES

This interface exists as mechanism to engage in a load balancing/redundant implementation with other COES. The COES will exchange information to other COESs if it is reaching its maximum load, and reroute any requests from the corresponding DSA to the available COES.

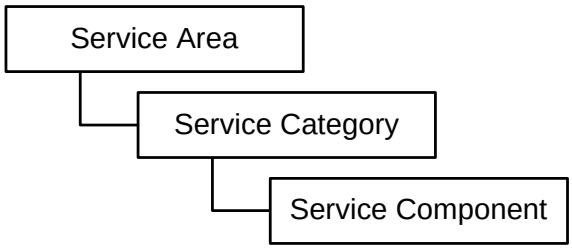
Exchanged information	Communication Protocols	Data Formats
Rerouted requests	Same as COES to DSA interfaces	Same as COES to DSA
Inter-COES messaging	Web Service (type – TBD)	TBD

5.4 Technical Standards View

The Technical Standards View, or TV, presents the guiding technical standards applicable to the IT architecture design and implementation.

5.4.1 TV-1 Technical Standards Profiles

The technical standards profile presented in this section consists of the table below and corresponds to the TV-1 product of the DoDAF. It consists of a listing of various technical standards that will serve as guidance and/or requirements for implementation and operation of the WIDB IT architecture. The TV-1 standards profile associates various service areas, service categories, and service components to specific standards and associated components from previous System View sections, specifically SV-1, SV-2, SV-4a, and SV-4b. The service areas, categories, and components are in accordance with the NOAA Enterprise Architecture Technical Reference Model (TRM) tailored as required for the WIDB IT architecture. The NOAA EA TRM taxonomy is grounded in the Federal Enterprise Architecture (FEA) Consolidated Reference Model (CRM) Version 2.1 and its hierarchy of service groupings and their descriptions are provided below:[3]



TRM Hierarchy Layer	Description and Purpose
Service Area	The highest level grouping of technology topics. This layer is highly abstract, and is included primarily to facilitate mapping of the NOAA TRM to the FEA TRM.
Service Category	A further decomposition of the high-level service areas into a logical grouping of more granular technology topics. This layer serves as the primary linkage between the TRM and Service/Application layers of the NOAA EA, and supports the allocation of technology topics to existing NOAA-wide committees (e.g., sub-committees of the CIO Council) for decision making purposes.
Service Components	Identification of the specific IT standards, specifications or products that have been approved (or prohibited) for use within NOAA.

[3] NOAA Enterprise Architecture Technical Reference Model, Version 1.0, September 2007.

The TV-1 technical standards profile shown below is initially intended as guidance for the architecture design and should be revisited throughout the design and implementation for updates as additional standards are identified for different services and as specific standards are agreed upon for each service component and associated system, function, and data flow.

Service Area	Service Category	Service Component	Standards	SV-1 & SV-2 Systems	SV-2 Communications	SV-4a Service Function	SV-4b Service Data Flow
Service Access & Delivery	Delivery Channels	VPN / Private Networks	MPLS	Cube Input Edge Service, Cube Output Edge Services	NOAAnet	Ingest Mgmt, Cube Request / Reply Mgmt, Subscription Mgt, Cube Retrieval Mgmt, Discoverability Mgmt, Security Mgmt, General System Mgmt, DSA Request Mgmt, DSA Retrieval Mgmt, Mediation Mgmt	Cube Input Edge Service, Cube Output Edge Service, Registry / Repository, NOAA Security Server, Mediation Service, FAA Inbound Destination Server

Service Area	Service Category	Service Component	Standards	SV-1 & SV-2 Systems	SV-2 Communications	SV-4a Service Function	SV-4b Service Data Flow
			MPLS, ATM,	Cube Input Edge Service, Cube Output Edge Services, FAA Destination Servers	SWIM / FTI	Cube Request / Reply Mgmt, Subscription Mgt, Cube Retrieval Mgmt, Discoverability Mgmt, Security Mgmt, General System Mgmt, DSA Request Mgmt, DSA Retrieval Mgmt, Mediation Mgmt	Cube Input Edge Service, Cube Output Edge Service, NOAA Security Server, Mediation Service, FAA Inbound Destination Server, FAA Destination Server, Cube Consumer Service Adapter, Consumer System
	Service Requirements	Legislative / Compliance	Section 508 (access for persons with disabilities)	Cube Input Edge Service, Cube Output Edge Service, FAA Destination Servers		Security Mgmt, General System Mgmt	FAA Destination Server, Consumer System
	Service Transport	Supporting Network Services	SNMP, LDAP, DNS, BGP	Cube Input Edge Service, Cube Output Edge Service, FAA Destination Servers		Platform Mgmt, General System Mgmt, Cube Retrieval Mgmt, Discoverability Mgmt, Security Mgmt	Cube Input Edge Service, Cube Output Edge Service, FAA Destination Servers, NOAA Security Server

Service Area	Service Category	Service Component	Standards	SV-1 & SV-2 Systems	SV-2 Communications	SV-4a Service Function	SV-4b Service Data Flow
		Service Transport	TCP/IP, HTTP, FTP	Cube Input Edge Service, Cube Output Edge Service, FAA Destination Servers	NOAAnet, FTI	Ingest Mgmt, Storage Mgmt, Cube Request / Reply Mgmt, Subscription Mgt, Cube Retrieval Mgmt, Discoverability Mgmt, Security Mgmt, General System Mgmt, DSA Request Mgmt, DSA Retrieval Mgmt, Mediation Mgmt	Source System, Source Service Adaptor, Cube Input Edge Service, Cube Output Edge Service, NOAA Security Server, Mediation Service, FAA Inbound Destination Server, FAA Destination Server, Cube Consumer Service Adapter, Consumer System
Service Platform & Infrastructure	Support Platforms	Platform Independent	JAVA, Linux				
		Platform Dependent	Windows (XP Professional)				
	Delivery Servers	Web Servers	Apache, Microsoft IIS,	Cube Input Edge Service, Cube Output Edge Service, FAA Destination Servers		Cube Request / Reply Mgmt, Cube Retrieval Mgmt, DSA Request Mgmt DSA Retrieval Mgmt	Cube Input Edge Service, Cube Output Edge Service, FAA Destination Servers

Service Area	Service Category	Service Component	Standards	SV-1 & SV-2 Systems	SV-2 Communications	SV-4a Service Function	SV-4b Service Data Flow
		Application Servers	Linux, Windows				
	Hardware / Infrastructure	Servers / Computers	*Ref Section 7.2*				
		Wide Area Network (WAN)	MPLS, ATM,	Cube Input Edge Service, Cube Output Edge Service, FAA Destination Servers, Security Services, Mediation Services, Administrative Services, Registry / Repository	NOAAnet, FTI	Ingest Mgmt, Storage Mgmt, Cube Request / Reply Mgmt, Subscription Mgt, Cube Retrieval Mgmt, Discoverability Mgmt, Security Mgmt, General System Mgmt, DSA Request Mgmt, DSA Retrieval Mgmt, Mediation Mgmt	Cube Input Edge Service, Cube Output Edge Service, Source System, Registry / Repository, NOAA Security Server, Mediation Service, FAA Inbound Destination Server

Service Area	Service Category	Service Component	Standards	SV-1 & SV-2 Systems	SV-2 Communications	SV-4a Service Function	SV-4b Service Data Flow
		Local Area Network (LAN)	Ethernet	Cube Input Edge Service, Cube Output Edge Service, FAA Destination Servers, Security Services, Mediation Services, Administrative Services, Registry / Repository		Ingest Mgmt, Storage Mgmt, Cube Request / Reply Mgmt, Subscription Mgt, Cube Retrieval Mgmt, Platform Mgmt, Discoverability Mgmt, Security Mgmt, General System Mgmt, DSA Request Mgmt, DSA Retrieval Mgmt, Mediation Mgmt	Cube Input Edge Service, Cube Output Edge Service, Source System, Source Service Adaptor, Registry / Repository, NOAA Security Server, Mediation Service, FAA Inbound Destination Server
	Database / Storage	Database / Database Server	PostgreSQL, IRIS	Cube Input Edge Service, Cube Output Edge Service		Ingest Mgmt, Storage Mgmt, Cube Request / Reply Mgmt, Subscription Mgt, Cube Retrieval Mgmt, Discoverability Mgmt	Cube Input Edge Service, Cube Output Edge Service

Service Area	Service Category	Service Component	Standards	SV-1 & SV-2 Systems	SV-2 Communications	SV-4a Service Function	SV-4b Service Data Flow
			ORACLE	FAA Destination Servers		DSA Request Mgmt, DSA Retrieval Mgmt, Mediation Mgmt	FAA Destination Servers
	Metadata Management	Geospatial / Scientific Metadata	FGDC, ISO, WSDL	Cube Input Edge Service, Cube Output Edge Service, FAA Destination Servers, Mediation Services, Registry / Repository		Ingest Mgmt, Storage Mgmt, Cube Request / Reply Mgmt, Subscription Mgt, Cube Retrieval Mgmt, Discoverability Mgmt, DSA Request Mgmt, DSA Retrieval Mgmt, Mediation Mgmt	Cube Input Edge Service, Cube Output Edge Service, Source System, Source Service Adaptor, Registry / Repository, Mediation Service, FAA Inbound Destination Server, Consumer System
Component Framework	Software Components	Office Automation Applications	Microsoft Office 2003, Adobe Acrobat				

Service Area	Service Category	Service Component	Standards	SV-1 & SV-2 Systems	SV-2 Communications	SV-4a Service Function	SV-4b Service Data Flow
	Data Interchange	Data Exchange	WFS, WCS, WMS, SOAP, HTTP/HTTPS, FTP	Source Service Adapter, Cube Input Edge Service, Cube Output Edge Services, Mediation Services, FAA External Destination Server, Destination Service Adaptor	NOAAnet, FTI	Cube Input Edge Service, Cube Output Edge Service, Cube Request / Reply Mgmt, Cube Retrieval Mgmt, Discoverability Mgmt, DSA Request Mgmt, DSA Retrieval Mgmt, Mediation Mgmt	Cube Input Edge Service, Cube Output Edge Service, Cube Source Service Adaptor, NOAA Security Server, Cube Consumer Service Adaptor, Destination Server, Registry/Repository, FAA Inbound DS, Consumer System
Service Interface & Integration	Integration	Web Services	WFS, WCS, WMS	Cube Input Edge Service, Cube Output Edge Services, Mediation Services, FAA External Destination Server, Administrative Services		Cube Input Edge Service, Cube Output Edge Service, Cube Request / Reply Mgmt, Cube Retrieval Mgmt, Discoverability Mgmt, DSA Request Mgmt, DSA Retrieval Mgmt, Mediation Mgmt	Cube Input Edge Service, Cube Output Edge Services, Mediation Services, FAA External Destination Server

Service Area	Service Category	Service Component	Standards	SV-1 & SV-2 Systems	SV-2 Communications	SV-4a Service Function	SV-4b Service Data Flow
	Interoperability	Data Format / Classification	WXXM, JMBL, netCDF, XML, HDF, OPeNDAP, GRIB, BUFR, ASCII	Cube Input Edge Service, Cube Output Edge Services, Registry / Repository, Source Service Adaptor, Destination Service Adaptor		Cube Input Edge Service, Cube Output Edge Service, Ingest Mgmt, Storage Mgmt, Cube Request / Reply Mgmt, Subscription Mgmt, Cube Retrieval Mgmt, Discoverability Mgmt, DSA Request Mgmt, DSA Retrieval Mgmt,	Cube Input Edge Service, Cube Output Edge Service, Source System, Registry / Repository, FAA Destination Server, Consumer System

Service Area	Service Category	Service Component	Standards	SV-1 & SV-2 Systems	SV-2 Communications	SV-4a Service Function	SV-4b Service Data Flow
		Data Transformation	WXXM, JMBL, netCDF, XML, HDF, OPeNDAP, GRIB, BUFR, ASCII	Source Service Adapter, Registry / Repository, Destination Service Adapter	NOAAnet, FTI	Ingest Mgmt, Storage Mgmt, Cube Retrieval Mgmt, DSA Cube request/reply Mgmt, DSA Retrieval Mgmt	Cube Input Edge Service, Cube Output Edge Server, Source Service Adaptor, Registry / Repository, Mediation Service, FAA Inbound Destination Server, Destination Service Adapter

6 Additional Design Considerations

6.1 Configurations

Definitive requirements associated with the performance and availability are still unclear; however, these will weigh heavily on the required supported configurations associated with Cube components. The initial design is being developed to support any of a number of potential configurations, including:

- Redundancy / fault tolerance peering – to allow for automated failover and rapid recovery from equipment and network failures
- Dedicated access – to allow for assured access with fixed latency and performance needs for differing consumers of Cube weather data
- Centralization – to allow for centralization of operations if needed, and more efficient sharing of resources as required

6.2 Security Services

The details associated with design of Security Services and their interactions with other Cube components, both internal to NOAA and with the FAA, will remain undefined until further progress is made in defining security requirements, and coordinating an interoperable security approach with the FAA. Whether these Security Services are built into other components of the Cube, or will exist as standalone, or shared services is also undecided at this early stage of the design effort. However, the design concepts presented in this document should remain flexible enough to address the future direction that these decisions will take it.

6.3 Mediation Services

The details associated with design of Mediation Services and their interactions with other Cube components, both internal to NOAA and with the FAA, will remain undefined until a definitive decision can be made concerning whether NOAA will be required to implement JMBL exclusively, as its solution, or whether some services / datasets may only be available via JBML. In those cases, some entity will need to provide the necessary translation between incompatible dataset formats or incompatible data exchange formats/protocols. Whether these Mediation Services are built into other components of the Cube, or will exist as standalone, or shared services is also undecided at this early stage of the design effort. However, the design concepts presented in this document should remain flexible enough to address the future direction that these decisions will take it.

6.4 Administrative Services

The details associated with design of Administrative Services and their interactions with other Cube components, will be further evolved as more detailed design efforts proceed. Whether these Administrative Services are built into other components of the Cube, or will exist as standalone, or

shared services is undecided at this early stage of the design effort. However, the design concepts presented in this document should remain flexible enough to address the future direction that these decisions will take it.

7 Component Guidelines

7.1 Software

NextGen's vision calls for implementing complex software and standards across multiple organizations. The overall 4-D Cube architecture is based on a system-of-systems, which as in any design feature, has its advantages and disadvantages. There are many attractive advantages, but the biggest challenge is agreeing on common standards for communication amongst the participating organizations. That challenge is better described as programmatic as opposed to technical. The architecture/design needs to be flexible enough to account for the use of different standards within organizations, yet still remain interoperable as far as inter-organizational data exchange is concerned. Thus, the software not only needs to perform functions that meet the requirements listed in Appendix A – Technical Requirements of this document, it may need to be able to accommodate mediation amongst conflicting standards.

7.1.1 Design Guidance

NOAA' Technical Reference Model introduces a source of enterprise-level technologies that have been determined to be consistent with NOAA's overall business and technology drivers. Ideally, the design of the component software should be driven by the Technical Reference Model (TRM) and open-source standards. Utilizing common IT standards along with open-source standards, places NOAA in a good position to handle dynamic changes that a modern, evolving IT infrastructure introduces. Benefits include: technology reuse, enhanced interoperability, promotion of vendor independence, accelerated system implementation, optimized use of NOAA resources, etc.

7.1.1.1 SOA

A service oriented architecture (SOA) will be used to implement a system-of-systems using web services as the communication mechanism between disparate systems. In the SOA context, 'services' perform pieces of logic, where these services are made discoverable via the federated Registry/Repository. System developers can leverage the building blocks of existing systems, supplied through their respective services, to build customized solutions that may have otherwise only been realizable with costly point-to-point links.

The TRM defines web services as a software system identified by a URI, whose public interfaces and bindings are presented using XML. This incorporates technologies such as SOAP, WSDL, and UDDI.

7.1.1.2 Standards / Practices

The TRM also introduces middleware technology that enables the interoperability of services across an infrastructure. The following list presents middleware technologies the TRM suggests to as NOAA standards:

- Remote Procedure Call (RPC) – protocol allowing a program on a client computer invoke a program on a server computer.
- IBM WebSphere MQ – Software solution providing APIs, queue management, message routing, automatic failover, and load balancing. Message-Oriented Middleware (MOM) is supported.
- Database Access: PL/SQL – Oracle's extension to SQL. Provides access to and across multiple database technologies in distributed environment.
- OPEN ANSI SQL/92 – SQL92 is the industry standard for SQL which promotes portability and interoperability of database application programs, and is a standardized way for embedding SQL statements into application development languages.
- Common Object Request Broker Architecture (CORBA) – Architecture provides a language-independent way for objects to communicate with one another.
- Component Object Model (COM) – Software architecture, developed by Microsoft, to design and build component-based applications.

Additionally, in following the NextGen's vision, open-source standards should be taken in consideration as much as possible, therefore the development of solutions requiring COTS software should be minimized.

7.1.1.3 Databases

Database technology plays a fundamental, transparent role in achieving NextGen goals. For instance, in order to query data across multiple data stores for multiple parameters during a specified time window, data needs to be stored so that it is easily accessed in an automated manner amongst users in a system-of-systems. Of the many database technologies that exist (object-oriented, relational, key/value), relational databases has been deemed appropriate to meet NextGen requirements.

By utilizing Relational Database Management Systems (RDBMS), (e.g, Oracle or IRIS), complex queries involving all four dimensions (3 spatial, 1 temporal) can be efficiently handled. RDBMS offer a large suite of functionality typically including a framework to provide high availability, load balancing, and replication amongst common data stores in the network.

The TRM does not have an approved enterprise standard for this component, but lists Oracle, Database 2 (DB2), SQL server, and MySQL as viable DBMS. Again, open-source standards should be kept in mind in the design process.

7.1.2 Implementation Options

The diversity in software implementation options necessitates a strong dependency on the metadata (ontology) used to classify data, and the database technology used to store the data. These factors will

ultimately drive how users query for data. Several implementation options are discussed below, but the decision on which implementations will be used is beyond the scope of this document, but at this point it seems likely that the Cube will support multiple options (WFS/WCS RI's and JMBL) in order to accommodate different organizational technological abilities and respective current investments.

7.1.2.1 Web Feature Service

FAA RI (Reference Implementation)

FAA's WFS RI encompasses the work done at MIT Lincoln Labs. It is based on the OGC WFS specifications with extensions to meet specific NextGen requirements. It incorporates a standard protocol for accessing feature (non-gridded) data. The WFSRI utilizes Oracle as its backend data store for feature data storage. Also, the FAA's RIs utilizes many FAA SWIM program components for its Core services. As NOAA does not have operational access to this SWIM components, those that are not directly portable, may need to be redeveloped for compatible within the NOAA infrastructure.

GSD Modified FAA RI

GSD is currently investigating adapting the FAA developed RI for NOAA's purposes. Instead of using the standard Oracle package, NOAA is considering (and GSD is investigating) using Oracle Express (XE) which has limited functionality and security when compared to the full suite Oracle offers, but is a free, more open source version.

GSD developed RI

Another alternative is for GSD to develop a NOAA-specific RI that is completely independent of Oracle. A PostgreSQL/PostGIS based relational database is a viable option.

PostgreSQL is an open-source object-relational database system. It supports a large part of the SQL standard and offers many modern features: complex queries, triggers, transactional integrity, and others. In addition, it can be extended by the user in many ways by adding new data types, functions, operators, aggregate functions, index methods, and procedural languages.

PostgreSQL /PostGIS database may have some performance impacts when compared to Oracle.

IRIS-based solution

Inter-Regional Integrated Services (IRIS) is a PostgreSQL/PostGIS database implementation using J2EE (Java Enterprise Edition) for enterprise-level information sharing. Currently, IRIS uses Java Object Model to store feature data. NOAA already is implementing this IRIS model within several systems such as: RIDGE, iNWS, and soon, NWSChat. This may also be a viable technology on which to base an WFS implementation.

7.1.2.2 Web Coverage Service

FAA RI

Similar to the FAA WFSRI, the FAA WCSRI is based on the OGC WCS specifications with extensions to meet NextGen requirements. It incorporates a standard protocol for accessing coverage (gridded) data. The WCSRI utilizes the SWIM architecture and thus the SWIM container which has a suite of Core Services. Like the WFSRI, work may need to be done on NOAA's side to replicate that functionality within SWIM that is not portable to the NOAA infrastructure.

7.1.2.3 AF WMS RI

Adapted AF WMS

AFWA has developed a WMS to serve the needs of their meteorological community. Work is underway by GSD to determine the effort required for NOAA to make use of this WMS implementation.

GSD-developed WMS

GSD is also investigating the development of a custom WMS RI for NOAA.

7.1.2.4 Joint METOC Broker Language

AFWA JMBL

JMBL is a standard developed by the Air Force Weather Agency and United States Navy to support Meteorological and Oceanographic Data (METOC), in both gridded and non-gridded formats. It is both a data model and service. JMBL was developed to fit the needs of the Department of Defense (DoD) meteorological and oceanographic (METOC) communities, and precedes many of the OGC and International Organization for Standardization (ISO) standards developed for geospatial data. JMBL has been developed and used primarily within the US Air Force and US Navy.

If JMBL is supported, it encompasses functionality similar to that the WFS/WCS RI's offer. GSD is investigating the usefulness of the AFWA JMBL solution for NextGen purposes.

7.2 Hardware

7.2.1 Design Guidance

To be supplied at a later date.

7.3 Communications

For NOAA, Cube communications will be provided primarily over NOAANet. The CIES/COES will utilize NOAANet for Reg/Rep access and the connection to FTI is intended to be provided through NOAANet. However if in certain cases, NOAANet cannot meet the specific performance requirements for a customer to access a particular dataset/product, direct connections to a CIES may be used, or a connection to a NOAANet node via a non-NOAANet communication link or dedicated NOAANet link, may be consider.

7.3.1 Applicable Standards/Protocols

Communication links / protocols and subsequent front-ends in component systems interfacing with NOAANet should take into account any applicable standards NOAANet imposes.

7.3.2 Physical Interfaces

Physical interfaces between Cube components should abide by applicable NOAANet specifications.

7.3.3 Security

The TRM defines secure web transport protocols as end-to-end management of a secure communications session. It introduces SSL, S/MIME, and TLS as secure web transport protocols. Security controls traversing through NOAANet should be compliant with all relevant NOAANet security protocols / standards.

Secure web services protocols include:

- Web Services Security (WS Security)
- Security Assimilation Markup Language (SAML)

8 Transition Plan

The tentative plan for development is as follows:

- Continued refinement of architecture and design
  - Based on the incorporation of additional (and refined) requirements collection / derivation efforts
  - Based on continued coordination efforts with FAA architecture design / development teams
- Development of prototype Reference Implementations of various Cube components
  - The validate key concepts
  - To demonstrate progress
  - To support on-going interoperable technology demonstrations
- Creation of a vendor procurement / acquisition package
- Selection of a vendor to create operational Cube components (based on prototype RIs) and to work with data providers and consumers in creating their respective Service Adaptor implementations
- Vendor development and deployment of Cube components
- Data providers system integration (service adaptor development) into the Cube

Specific timeframes for these transitional activities are under consideration.

9 Open Issues / Risks

As high level open issues and risks related to the design become identified, they will be tracked in this section. Since more detailed open issues related to the design will be identified, addressed, and resolved on a continuous basis, these will unlikely be tracked in this document.

As of now, the following open issues and risks that may impact NOAA's NextGen IT Architecture and Design are summarized below.

9.1 JMBL vs WXXM for non-gridded data & JMBL (SOAP) vs WCS/WFS

NOAA is still in the midst of investigating whether to implement JMBL as its web service and non-gridded data format. The FAA has chosen to implement OGC-based WCS/WFS web services and WXXM as the non-gridded data exchange format. This introduces the potential for incompatibilities between the NOAA and FAA portion of the Cube, including business rules mismatches, format mismatches, etc and impacts the usefulness by NOAA of any of the FAA's RI efforts. The current NWS direction is to assume that access to all data sources provided by NOAA would be via both a concurrent JMBL and OGC-based web service and that mediation between JMBL and WXXM-formatted non-gridded data would need to be performed somewhere (whether by NOAA or the FAA is still an issue). Mediation (conversion) of NOAA provided data not in these formats must also be implemented either by NOAA in the CIES, or FAA in their requesting Distribution Server or a standalone mediation service that the FAA would need to developed and field. This is obviously duplicate effort in standing up both versions of web services and added effort to perform such format translation / mediation.

9.2 Gridded Data Exchange

The FAA is intending on providing all gridded data requested from their sources in NetCDF4 or GRIB2. Any translation from these formats into formats compatible with requesting NOAA systems will be the responsibility of NOAA.

9.3 Use of Oracle as RI Baseline

The FAA RIs are being developed based on Oracle as its native database. NOAA policy strongly encourages the use of open source software to avoid exorbitant costs associated with such COTS SW. Non-Oracle-based RIs may need to be developed before they could be used by NOAA.

One of the current versions of JMBL also uses Oracle as its database as well, so effort would likely be required to develop a non-Oracle-based JMBL implementation as well.

9.4 Decision on Use of RIs by NOAA Data Providers

NOAA must decide whether to make use of the RIs being developed by FAA. Some constraining factors include the use of Oracle as the native database, and the use of FAA-specific FUSE/SWIM technologies as the basis for the RIs, which are not available to non-FAA entities.

9.5 Single Requirement Source

No single source of requirements exists for the IT portion of the Cube. Many of the disparate sources of potential requirements either conflict or are too vague to produce detailed requirements from.

9.6 Textual / Graphical / Binary Products

In the past, the FAA did not have any concrete requirements for the exchange of textual or graphical formatted products within the Cube. The WCS/WFS RIs are not capable of supporting these formats (although there has been discussion the textual products can be encoded in WXXM format at the source and decoded back to text prior to delivery to the requesting legacy system). However, recent FAA efforts have identified that graphical (and text) wx products may be necessary, so corresponding Web Services (e.g., WMS) and supporting formats may need to be defined. There is also questions about whether and how to support binary data exchange.

9.7 Performance Requirements

Performance requirements associated with the IT architecture are sparse or non-existent for many cases, especially for IOC. There appears to be no effort currently defined by the FAA to focus on IT performance requirements. Mention has been made to "use the current performance as a benchmark and do no worse" but effort would be required to determine what these current performances are as well.

The format for defining use cases in the IT Conops document is being changed to create a placeholder to include performance needs associated with each use case, but it is still unclear where these performance criteria will come from.

9.8 Security Requirements / Implementation

Security related requirements are not fully defined at this stage. Initial efforts are underway to better address the security issues associated with the Cube.

9.9 Additional Use Cases to be Developed

More specific and some additional use cases need to be developed to better address the breadth of requirements that must be met by the Cube. These use cases may generate additional requirements for the IT implementation. For instance, additional use cases are being prepared to address:

- Verification
- Cube support for text/graphic products

9.10 NOAANET to FTI Connectivity Concerns

Details of how the NOAA portion of the Cube will connect to the FAA FTI/SWIM environment (and all the associated security concerns) must be addressed.

9.11 Identifying NOAA-Internal Users of Cube Data

Many products and data generated by NOAA are available via numerous systems. For each required Cube product, a decision must be made to identify which specific system will be responsible for providing that product, especially where products might be available from multiple locations / sources.

9.12 Identifying Product & Data Formats and Sizes

A fairly intensive effort remains to jointly agree to data formats and identify expected sizes / volume of each product and dataset that will need to flow through the Cube.

9.13 Handling of Varying QOS and Tiered Access Needs

There will likely be consumers of Cube data that will have very different performance requirements from one another. Some may need immediate (and possibly direct) access, whereas others may have no time critical needs. Both the NOAA and FAA architectures must support this tiered access requirement consistently.

9.14 Pub / Sub Details

Currently, the FAA is considering a Pub/Sub implementation that is tightly coupled to the native capabilities supported with Oracle. There a is strong need to define an Pub/Sub implementation and its respective message exchange that not only allows that interoperability, but is based more standardized WS standards.

9.15 File Retrieval

The FAA WCS RI Gridded data file delivery is intended to be handled as a SOAP message with attachments. The standards allow for a notification that the data is available for retrieval, along with the temporary storage location of the data (which is also how JMBL functions). Additional discussion is necessary to determine if this notification/retrieval approach should be supported as well.